LAMPAS:

OR,

DESCRIPTIONS

OF SOME

Mechanical Improvements

OF

Lamps & Waterpoiſes.

Together with ſome other

PHYSICAL and MECHANICAL

DISCOVERIES.

MADE BY

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Fig. 4 pag. 24. l 24
& pag. 44

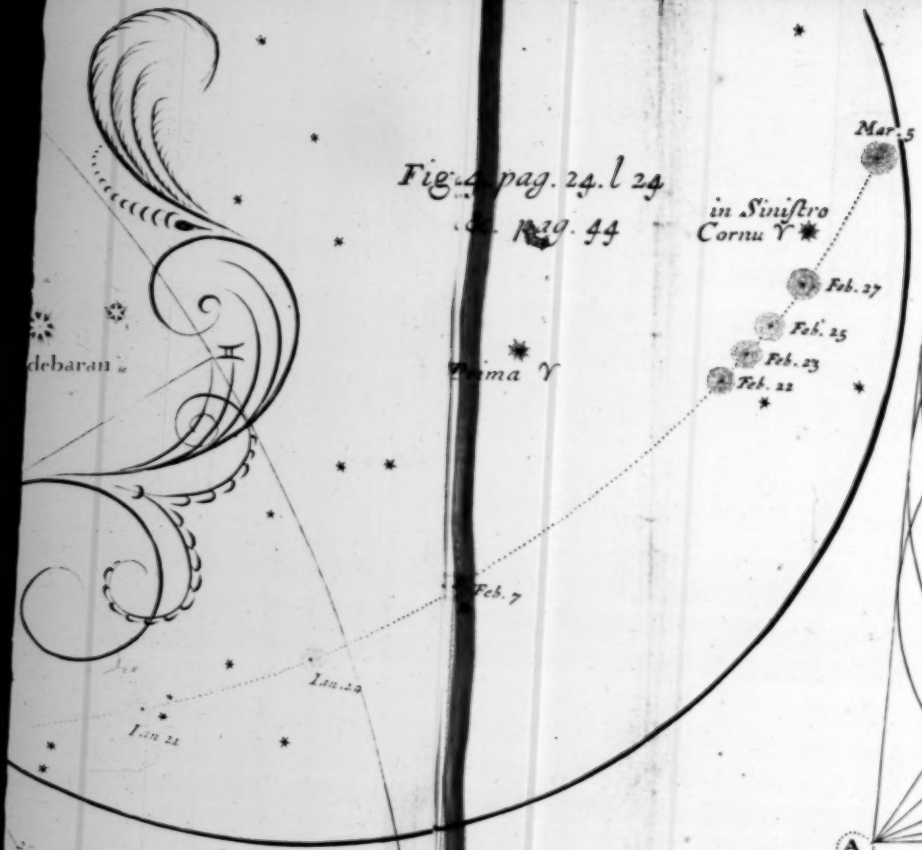
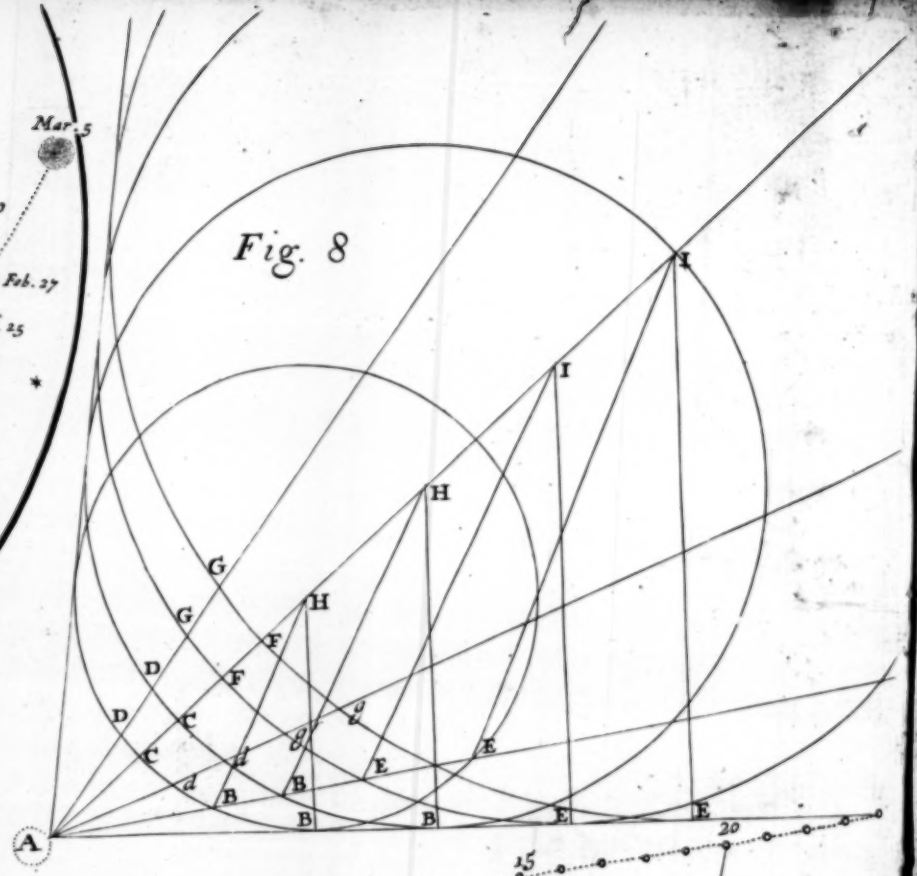
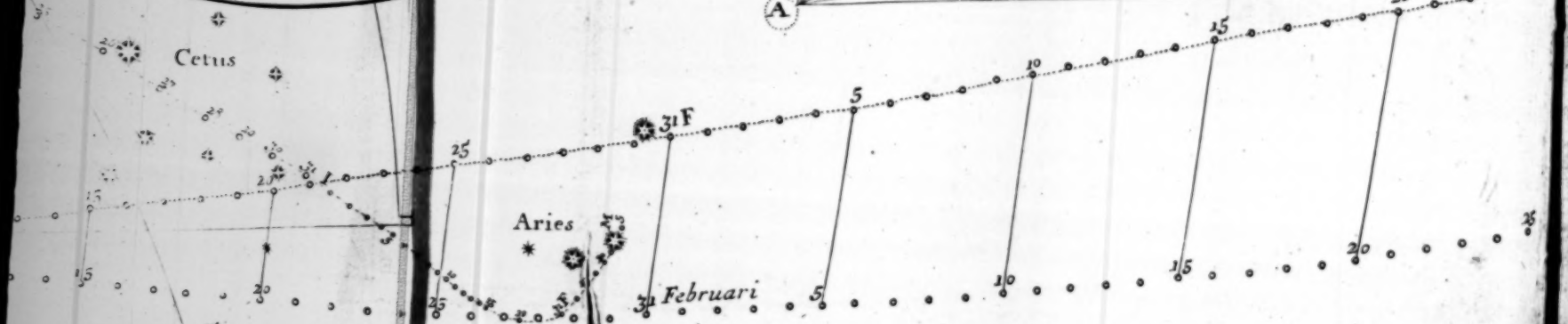


Fig. 8





LAMPAS:
OR, A
DESCRIPTION
OF SOME
Mechanical Improvements
OF
LAMPS.

THe Hypotheſis of Fire and Flame I did about eleven years ſince publiſh in the 16. Obſervation *Pag.* 103, 104, and 105. of my *Micrographia*, which hath ſo far obtained, that many Authors have ſince made uſe of it, and aſſerted it; nor have I yet met with one conſiderable objection againſt it. It ſhall not therefore be my buſineſs at preſent to diſcourſe of, or farther explain that Theory, which any one upon a ſtrict inquiry into, I queſtion not, will find cauſe ſufficient to confirm him in, but rather to mention ſome pleaſant and beneficial uſes thereof, and to hint ſome Mechanical contrivances for the ſupplying the *Pabulum* Oyl or Spirit by the ſame Degrees by which it is conſumed in the flame of a Lamp, that great diſſolvent.

I do not here deſign to ſhew a way how to make a perpetual Lamp, that being a Chimera which my Hypotheſis of flame doth ſeem to deſtroy, for the diſſolvend muſt in time be diſſolved; But to ſhew a way how to make

Tab: II.[a]

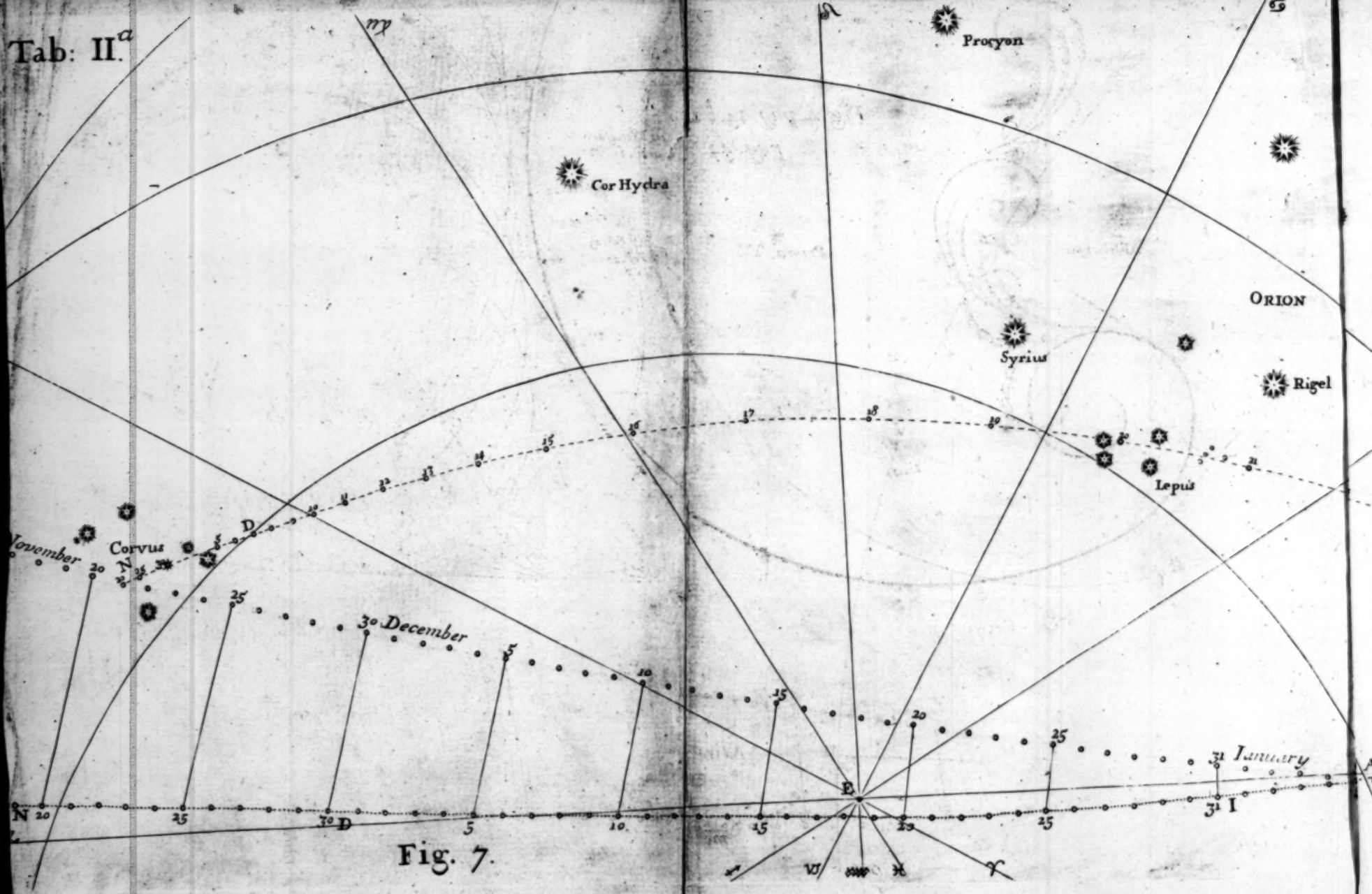

Cor Hydra
Procyon
Orion
Syrius
Rigel
Lepus
Corvus
November
December
January
D
N
E

Fig. 7.

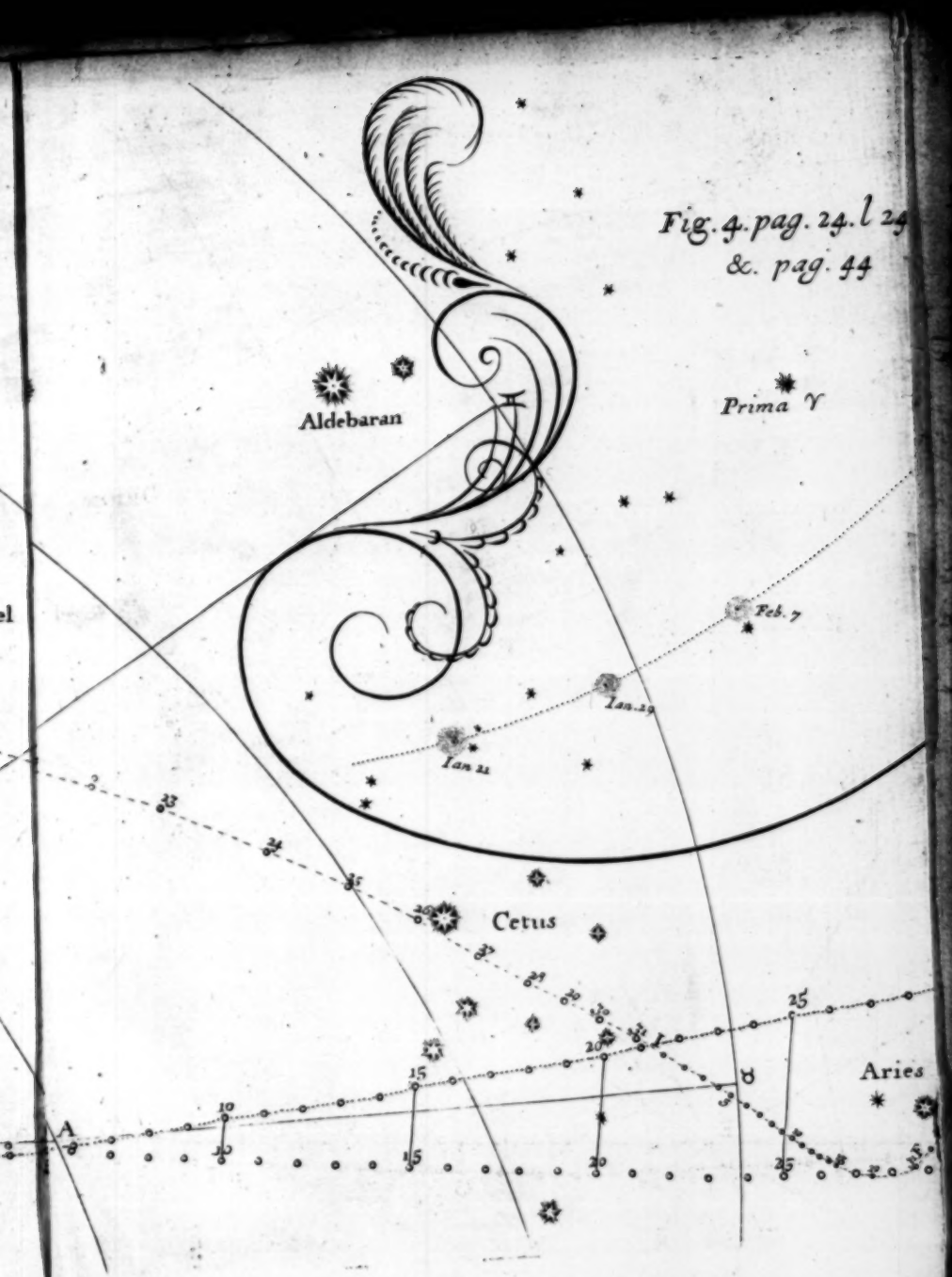


Fig. 4. pag. 24. l 29
& pag. 44
Aldebaran
Prima ♈
Feb. 7
Jan. 29
Jan. 21
Cetus
Aries
♉
A

the Receptacle of a Lamp in such manner as that it shall continue to supply the *Pabulum* to the flame equally and for a very long time till it be all consumed. The consideration of which Problem first put me upon the enquiry after a counterpoise for Liquors or Fluids, which is also of very great use in Hydraulicks, as I shall hereafter have occasion to manifest.

This I can do by very many contrivances, depending from very differing Principles, all and every of which may be fitted so as to supply the Oyl or *Pabulum* of the Lamp in such quantity, and after such manner and proportion as shall be desired. I shall now omit all the other ways of performing this effect, though divers of them are as much or more considerable than any of these I here mention. And having promised in the 32 Page of my description of Helioscopes to publish a Counterpoise for Liquors, I shall only explain several ways by the help of these Counterpoises to do whatsoever can be required, as to the manner and quantity of supplying Oyl to the flame.

The chief design of the Counterpoise in this inquisition is to keep the Superficies of the Liquor (whether Oyl, Spirit of Wine, Oyl of *Turpentine*, or the like) whatever quantity there be in the Vessel, always to the same height, so that the said *Pabulum* shall always be equally distant from the bottom of the flame, and the Wick or flame being once placed at a convenient height or distance above the Superficies of the Oyl, shall not be deserted by the said Superficies till the whole quantity be consumed; but it is as easie to contrive it, to supply it by decreasing or increasing degrees, which are conveniences that none of all the Lamps I have ever yet met with have had, that was tolerable for use. The most ingenious is that which is commonly known by the name of *Cardans* Lamp, as being published and very probably invented by *Cardan*, which doth in some manner supply the wasting and decay of the Oyl caused by the flames Consumption. But then it is subject to a great many inconveniences,

veniences, which make it intollerable and diſuſed: The firſt is, though it doth ſupply the defects of the Oyl to the Wick, yet it doth it not conſtantly and equally, but by ſtarts and gluts; for after the receptacle by the Wick is filled, the Superficies of the Oyl continues to ſink by degrees a conſiderable ſpace below the flame, before there be any more ſupply added from the great Magazine or Repoſitory, and till the Air can break in, (which it doth very unequally) ſo that there ſometimes comes down ſo great a quantity that the receptacle is over-filled, and the flame extinguiſhed, and theſe gluts are more unequal the bigger the Magazine be in proportion to the Receptacle by the flame, and the more the quantity of the Oyl be that is ſuſpended, and the more the Air ſpace be above the Oyl, and the more tenacious or ſluggiſh the conſtitution of the Oyl is.

The ſecond inconvenience of *Cardans* Lamp is that the Air is apt to rarifie it with heat, ſo as ſometimes to drive down ſo much Oyl as to overflow the receptacle, and choak the flame.

The third Inconvenience is, that the Wick by the ſinking of the oyl doth ſooner decay the flame, being ſometimes a little higher and ſometimes lower upon the Wick; for if the Wick riſe up into the hollow dead part of the Cone of the flame, the ſtreams and coals of the Oyl will be ſo caked together as to dead the flame and much to diminiſh the light and heat thereof, whereas if the Wick be but ſhort, and ſuffered only to go but a very little within the under-Superficies of the flame, it will not be ſo ſtopped and caked with thoſe feculencies. The reaſon of which is evident, for the flame, as I formerly proved, being nothing but the parts of the Oyl rarified and raiſed by heat into the form of a vapour, ſmoak, or ſteam, the free Air that incompaſſeth this ſteam keepeth it into a Cylindrical form, and by its diſſolving property preyeth upon or diſſolveth thoſe parts of it that are outwards and next to the Air, ſo as by the ſaid diſſolution it continueth the heat, and produceth the light which we obſerve; but

thoſe parts of the body of ſteams that riſe from the Wick, which are in the middle, and not contiguous to the outward Air, are not diſſolved or turned into ſhining flame by the Air till they riſe towards the top of the Cone of flame where the free Air can come to reach, and ſo to diſſolve them, and thence gathering about the Wick in the Center of the Cone of flame they choak, clog, and quite ſtifle it that the flame will quickly go out. That this is ſo, any one may eaſily find if he examine the flame of a Lamp or Candle by the help of a piece of glaſs: For by the tranſparency thereof he will plainly perceive that all the middle of the Cone of flame neither ſhines nor burns but only the outward Superficies thereof that is contiguous to the free and unſatiated Air, and that the middle parts may be collected in the form of Soot, or very fine powdered coal duſt.

Take then a piece of Glaſs, whether Window-Glaſs, Looking-glaſs Plate, or the ſide of a Viol, it matters not, or, which is beſt of all, a thin Plate of *Selenitis* or *Muſcovia* Talk, and hold it Horizontally in the middle of the flame, ſo as to cut off the top or upper part of the Cone thereof, then preſently, before it be choaked with ſoot, look down upon it, and you ſhall plainly ſee that all the middle parts of the Flame and the Wick have no ſhining power or light at all; nor are they diſſolved by the Air, but remain in the form of Soot, but that only the Superficies or outſide of the ſaid Cone doth burn, ſhine, and conſume into and mix with the ambient Air.

In the ſame manner, if you hold the Glaſs or Selenitis perpendicularly, and apply the ſide of it ſo as to cut the flame *per axin coni*, that the Air cannot come to one ſide thereof, you may plainly perceive that the ſhining part of the flame is only that which is contiguous to, and preyed upon by the free and unſatiated Air, and that where that Air cannot come free without being glutted and ſatiated in its way, there neither the conſumption of the Oyl, nor the heat and light of the flame is produced, but only a ſooty, choaking, and ſtifling ſubſtance.

To,

To make then the reaſon of the Phænomena obſervable about the laſting or ſtifling of the flame of a Lamp the more clear and eaſie to be underſtood and comprehended, give me leave to explain the manner of its production and continuation by a Scheme, delineation, and deſcription thereof.

Let A A then in the ſecond Table repreſent a body of Oyl, or any other combuſtible fluid ſubſtance, the Superficies whereof B B is Horizontal, and pretty near plain. [I ſay, pretty near, becauſe it is always either Concave, or Convex, more or leſs according to ſeveral circumſtances; to wit, the capacity and the nature of the Veſſel E E, in which it is contained; for if the Veſſel be ſmall, and that the Oyl hath a greater congruity with it than the Air, the Superficies of the Oyl will be very much concavated eſpecially towards the ſides of the Veſſel as at C C; but if the Veſſel be incongruous to Oyl, the Superficies will be Convex as at D D, the reaſon of which I have long ſince explained in another place.]

Let F E then in the third figure repreſent the Wick, which conſiſts of a great number of very fine Cylinders or hairs of Cotton f f f twiſted and laid very cloſe together, into, and between which the Oyl (having a very great congruity therewith) doth readily inſinuate it ſelf and adhere, and is by the preſſure of the Air (much greater without than between thoſe Cylinders or hairs) forced up to a conſiderable height between them, (as to the height of an inch and half, or two Inches) and if by any means the Oyl be taken out at the top thereof, the remaining part of the Oyl in the Veſſel will aſcend to ſupply the vacancy of the part drawn off, which is evident in Filtration. About the ſides of this Wick the Oyl will be ſure to aſcend, and the Superficies thereof will be concavated as at G G, becauſe unleſs there be a congruity between the Oyl and the Wick there will be no aſcent of the Oyl therein, and therefore that ſubſtance that the Oyl doth not readily adhere to cannot be a fit material for that purpoſe.

Now

Now to this Wick thus filled with Oyl apply the flame of a Lamp or Candle, or any other ſubſtance extremely hot, as a glowing piece of Iron, Copper, or the like, and by this means the parts of the Oyl in the Wick will be very much heated, and expand themſelves in vapours into the contiguous Air by the ſteams h h h h h, and fill all the Ambient ſpace of the Air H H therewith, which vapours being very much rarified, and conſequently lighter than the incompaſſing Air, are by the greater gravity and preſſure thereof carried upwards by the Curve Lines h i k. Theſe at firſt guſh out of the Wick at Right Angles, but by the protruſion of the Air are quickly turned into a kind of Parabolick Curve h i k The motion of the Particles in which is ſwifteſt in k k, that is to a certain degree of Altitude. The motion of aſcent increaſing ſomewhat after the nature of the motion of deſcent in heavy bodies, I ſay ſomewhat in that nature, for if the aſcending bodies were uniformly lighter than the Ambient they would be the ſame, but becauſe the rarefaction and nature of them is varied by Circumſtances, therefore it hath but part of that Analogy.

To proceed then with the Explication: I ſay, theſe ſteams of the Oyl thus aſcending, if they are heated to a ſufficient degree of heat are preyed upon, and diſſolved or burned by the Ambient Air; which diſſolution hath this effect, firſt, that it produceth light; next, that it produceth heat enough to make the ſucceeding parts of the ſteams that ruſh out of the Wick and follow after it to be ſufficiently heated for diſſolution by the Air, the heat of which produceth the ſame operation upon a third, and that upon a fourth, and that upon a fifth, and ſo ſucceſſively ſo long as there are ſteams of Oyl to be diſſolved, and plenty of freſh and unſatiated Air to diſſolve. The action alſo of this diſſolution cauſeth heat ſufficient to raiſe up the ſucceeding parts of the Oyl into the Wick, and expand them into vapours, and ſo to make them fit to be further heated and diſſolved. It is further obſervable in the flame of a Lamp, that thoſe vapours

that

that iſſue out of the Wick are by degrees diſſolved, and not all in a moment, for the parts of the flame that are lowermoſt about H have a kind of faint blew light until they come to I, where they ſeem to have their brighteſt and cleareſt light and heat, the ſaid vapours not being heated to that degree at their firſt breaking out that they afterwards acquire by the farther action of the Air upon them. At I they ſeem to be in their higheſt degree of diſſolution, and from thence upwards are made one with the diſſolving Air, ſo that they are not but by other means diſcernable to the eye of the obſerver; ſo that the ſhining part of this Conical ſhaped ſpace of the flame is only the outſide of the Cone, it being that part where the Ambient Air preys upon the aſcending eruptions of the Oyl, namely, where the Chain of ſmall Circles intercept the Curve lines of the motion of the aſcending eruptions.

This Figure and ſhape of the flame and vapours may be plainly ſeen by the help of a Metalline Concave placed at a certain diſtance and Poſition, and alſo by obſerving the ſhadow of the Candle caſt by the beams of the Sun upon a ſheet of white Paper, or white Wall, but that way of a Concave *ſpeculum* is incomparably beyond it, becauſe it doth ſo very plainly ſhew the form and manner of the ſteams riſing above i i i i, as about k k k k, &c.

The Air after it hath performed the action of Diſſolution, and is ſatiated and incorporated with the parts of the Oyl at i i i, aſcend by k k k, but ſhine not. All the ſteams or eruption of the vapours of the Oyl out of the Wick f f f ſhine not between the Wick f f and i i, but begin to be diſſolved, and to ſhine as they approach the freſh Air at i i, where the diſſolution is compleated.

The upper parts of the flame ſhine more than the lower, the parts having been heated to a much greater degree by the longer ſpace of paſſage they have had through the hot Concave part of the flame, and contiguous or very near to the glowing ſides thereof at i i i.

All the under parts of the Wick neither ſhine nor burn,

burn, but are as it were charkd by the extremity of the heat of the Conical Superficies of the flame, they are defended from burning at the bottom by the freſh acceſs of new Oyl from the Veſſel underneath; and the middle parts are defended from burning or ſhining by reaſon the Air cannot approach them before it be ſatiated at the Conical Superficies i i i by the diſſolution of the ſteams of the Oyl it there meeteth with. But the upper parts of the Wick do burn and ſhine, if they be high enough, into the ſmaller part of the Cone of flame that the Air before it be ſatiated can reach at them. And if any part of the Wick fall into the ſaid Conical and ſhining Superficies of the flame, it doth both ſhine and conſume, and ſuffers the ſame diſſolution into the Air as the ſteams of the Oyl, and if any part of this Wick be without this Conical Superficies at i i i, it is preſently conſumed and reduced to Aſhes; as by many experiments differing ways made is very plainly viſible.

This plainly gives the cauſe why knots and Tophus's do as it were grow to the Wick of the Lamp like ſo many Muſhrooms on a rotten Tree, which as ſoon as they are removed out of the middle and dead part of the flame are immediately conſumed by, and diſſolved into the Air, and ſhine like a coal of fire, as being indeed nothing elſe.

Hence we may give a plain Reaſon why upon applying any cool Superficies very low into the flame of a Lamp, there is immediately condenſed upon it a great quantity of ſoot, namely, that the middle parts of the Cone of flame, being nothing but a great number of oyly ſteams aſcending, are not fired nor conſumed by the Air, till they can come to be wrought upon by the free and unſatiated Air, Now if the Air be ſo intercepted that it cannot come at them, and the ſteams be cooled by the plates coldneſs that the Air is not able to prey upon or diſſolve them for want of a preparatory heat ſufficient, they muſt remain in the form of burnt Oyl, or Lamp-black.

I have been ſomewhat the longer and more particular

in

in this deſcription and explanation of my Theory of the flame of a Lamp or Candle, that ſo the Reader underſtanding the nature and cauſes thereof the more fully and plainly, he may the eaſier diſcover the inconveniences that may occur in the burning, heating, ſhining, duration, *&c.* thereof, and the ſooner and more readily and ſcientifically find a cure and prevention of thoſe inconveniences, which he that is ignorant of can but hoodwinked grope after, and at beſt can but hope poſſibly after long puzling himſelf in vain attempts and blind trials, nothing to the purpoſe, he may at length ſtumble upon that which had he been inlightned by the true Theory, he would have readily gone to at the firſt glance.

I could have further expatiated into the contemplation of this moſt admirable Phenomenon of flame, producing heat and light, the two moſt ſpirituous and moſt potent Agents in Nature, and the ways of Intending and Diminiſhing them, and the uſes that may be made of them, but that it is not my preſent deſign to annex a diſcourſe on thoſe ſubjects, which doth more properly belong to another Lecture I ſhall ſhortly publiſh. I ſhall therefore at preſent proceed only to ſhew ſome Mechanical contrivances for counterpoiſing Liquors in Veſſels, ſo as to keep them running or ſupplying a ſtream always with equal ſwiftneſs, whatever quantity there be of the ſaid Fluid; which as they are very convenient for perfecting Lamps for divers uſes, which they could not otherwiſe perform, ſo in Hydraulick they are of moſt admirable benefit for divers effects, hardly to be performed without them, as I ſhall hereafter manifeſt. But firſt, I will explain ſome few ways by which more conveniences may be obtained, and more inconveniences prevented in the uſe of Lamps for Chymical, Mechanical, and Philoſophical uſes than by this way of *Cardan*, or any other I have met with: For this I look upon as one of the Tools to be made uſe of in the Work-houſe or Elaboratory of Nature, without a good Apparatus of which, be the Workman otherwiſe

never ſo well accompliſhed, he will never be able to produce any very conſiderable effect; and with them, even a Bungler otherwiſe, will, if well furniſhed, do wonders to ſuch as know not the means by which they are done.

It may poſſibly ſeem very ſtrange to ſome to hear, that by the flame of a Lamp Plants may be made to grow, bear Leaves, blow Flowers, ripen Seeds; that the Eggs of Fowls and Inſects may be hatched, and brought to life and perfection; that Metals, even the hardeſt, Glaſs, Stones, *&c.* may be almoſt in a moment melted, ſoftned, liquified, hardned, *&c.* that thouſands of ſeparations of conjoyned and naturally united bodies may be effected, and they reſerved diſtinct; and as many other bodies, naturally diſtinct, and very differing, may be united and compounded into Homogeneous mixtures, ſome ſcarce ſeparable afterwards; that Glaſs may be ſhaped and moulded like Wax; that almoſt all the ſenſible qualities of bodies may be increaſed, diminiſhed, annihilated, and created; and ſome alſo of the qualities inſenſible (otherwiſe than by the effects;) and yet even theſe, and many more, may be effected by this Tool or Inſtrument, if rightly uſed, as I could manifeſt if I had now time. But I ſhall not here any further expatiate on it, poſſibly I may hereafter but at preſent I ſhall only proceed to the deſcription of one ſort of thoſe Inſtruments which ſerve to ſupply the Oyl or *Pabulum* of a Lamp conveniently by any degrees, and in what quantity is deſired. This ſort doth depend upon ſome contrivance of Counterpoiſes for the Liquor in the Receptacle that is to feed the Lamp, and may be made uſe of in Hydralicks as well as Lamps to feed and continue any running ſtream any time deſired.

Theſe Counterpoiſes then of Fluids might be made to feed the flame of a Lamp equally for any time aſſigned, and conſequently would make a kind of Perpetual Lamp, but the *Pabulum* it ſelf will be ſome ways or other unapt for ſuch an effect; as Oyl hath a foulneſs whereby the Wick

Wick is choaked or ſtopped, ſo as that it will no longer aſcend in it; Spirit of Wine will in length of time evaporate and loſe much of its nature; and other Oyls have their ſeveral defects which make them uncapable of continuing the flame very long. But there are none of theſe that I have met with but may be in great meaſure avoided by the help of ſome Chymical or Mechanical contrivances, ſome inſtances whereof I ſhall hereafter give, which the Theory of Fire and Flame doth readily hint.

The firſt way then I ſhall now deſcribe is by a round Box, the inward Cavity of which is divided by a Diaphragm into two equal parts, and fitted with a proper Counterpoiſe, the Axis of whoſe motion lieth Horizontally. The contrivance of which will be more plainly underſtood by the Delineation thereof in the firſt place, where the ſecond Figure repreſents the whole Inſtrument, with its Globe, Frame, Pedeſtal, Socket, and lighted Lamp.

A repreſents the Pedeſtal or foot upon which the Inſtrument ſtands, which may be made of Silver, Braſs, Wood, or the like. B C D E F, the Frame faſtned to the Pedeſtal, and ſhaped in the form of a Snake, perforated at B and D to receive the Pivots or Gudgeons of the Lamp G H, and hollow from E to F to ſerve to convey the Oyl or Spirit of Wine from the end of the hollow Gudgeon H to the Wick I, to feed the Flame K; the hole at E to receive the end of the hollow Gudgeon; H is made a little tapering, and the end of the Gudgeon H is ground fit into it, ſo as to turn eaſily, and yet ſo true, as not to let any Oyl there leak out, the ſaid Gudgeon being kept cloſe home by the ſpringing of the Arm B; the Superficies of the Oyl or Spirit for the *Pabulum* is always kept by the motion of the ſaid Globe upon its Axis G H, exactly in the Line L M, untill it be all conſumed, which how it is done will be better conceived by ſhewing the contrivance of the inſide of the aforeſaid Globe, how the ſame is divided, how filled, and how counterpoiſed.

Suppoſe then the aforeſaid Globe cut in ſunder by the middle Line or Circle N O, and diſcovering the Inſide or Cavity thereof to be repreſented in the firſt Figure, where P A H R Z P repreſents the aforeſaid Circle, or half ſhell of the Globe; O repreſents the middle of the hollow Gudgeon H, which is the Pole or Axis about which the ſaid Globe doth move. H O Z repreſents the Horizontal Line or Plain paſſing through the aforeſaid Axis; P R the Perpendicular to that Plain. Let H Z then repreſent a Diaphragm or Partition of the ſame material with the Globe, by which the Concavity thereof is divided into an upper Hemiſphere H P Z O H, and into an under Hemiſphere H R Z O H. Let the under Hemiſphere be filled with Oyl, Spirit of Wine, *&c.* or the like fit material for a Lamp to burn; and let the upper part be filled with ſome material of half the weight of the Oyl, Spirit, or other material, or becauſe that will be ſomewhat difficult to do, let there be a counterpoiſe of Lead or other ponderous matter fixed ſomewhere in the Line P O, ſo that the ſaid upper Hemiſphere ſhall have half the gravity of the under Hemiſphere upon the Center of motion O. I ſay, whatever quantity of the Fluid *Pabulum* is in the Cavity of the ſaid under Hemiſphere, the Superficies thereof ſhall always be in the Horizontal Line or Plain O Z, the counterpoiſed upper Hemiſphere keeping it always up to that height. For inſtance, ſuppoſing the ſaid Hemiſphere full, there is no doubt but that the under Hemiſphere being double the weight of the uppermoſt will be lowermoſt, and that Horizontal Line will lie Horizontally, ſince it is evident, that the Center of gravity of the whole will be below the Center of motion O, and ſomewhere in the Line O R, which is Perpendicular to the aforeſaid Plain. Next, ſuppoſe ſo much of the aforeſaid Liquid *Pabulum* conſumed as to leave enough only to fill the ſpace C O Z B R C, and the Diaphragm be moved from its Horizontal Poſition H Z, and placed in the Oblique Poſition C O D. I ſay, the ſaid upper Hemiſphere

CHAPDOC ſhall exactly counterpoiſe the ſaid under Hemiſphere CRBZDOC, ſo as the Superficies of Liquor ſhall be in the Horizontal Plain OZ. Make AP equal to PD, and draw the Line AOB through the Center O, it is manifeſt then that the Wedge COR of the Liquor doth counterpoiſe the Wedge ROB on the other ſide the Perpendicular, and that the Wedge POD of the upper Hemiſphere doth counterpoiſe the Wedge POA on the other ſide of the Perpendicular, ſo that neither of theſe have any prepollency to move the Globe out of this Poſture. Next, it is plain that the Wedge BOZ of the Liquor will be counterpoiſed by the Wedge AOC, which is double the bigneſs of BOZ, and conſequently of equal weight, the parts of the upper Hemiſphere being put of half the gravity or weight of the under Hemiſphere.

Next, ſuppoſe half the Oyl be conſumed, and there be only left enough to fill the quadrantal Wedge ZOR, I ſay, the Superficies thereof ſhall be in the Horizontal Line OZ; for ſince the upper Hemiſphere is half the weight of the under, the two quadrantal Wedges POH and HOR muſt neceſſarily counterpoiſe the quadrantal Wedge ROZ of the Oyl.

Thirdly, Suppoſe that more than half the ſaid Oyl or liquid *Pabulum* be conſumed, and that there be only left enough to fill the Wedge BOZ, I ſay, the counterpoiſing upper Hemiſphere now made the under, and placed in the Poſition AHCRBOA ſhall exactly counterpoiſe the ſaid Wedge of Liquor, ſo as that the Superficies thereof ſhall be in the Line OZ; for the Wedge ROB of the aforeſaid upper Hemiſphere doth counterpoiſe the Wedge COR on the other ſide of the Perpendicular, and the double Wedge AOH and HOC will counterpoiſe the Wedge BOZ.

Nor can the Superficies of the Liquor be any whit higher or lower than the Line OZ, for if it be any whit higher as at EF, the Liquor muſt neceſſarily overpoiſe the aforeſaid Wedge AOC, by all the weight of the Liquor

Liquor contained in FGOZF. And if it be any whit lower as at IK, the Wedge KIB muſt be too light for the counterpoiſing Wedge AOC by the weight of the Liquor contained in the ſpace ZOTKZ, ſince I juſt now ſhewed that AOC did juſt counterpoiſe ZOB, which was the thing to be proved.

Now though in this Inſtance I have choſen to explicate I have made choice of a Globe, yet that form is not neceſſary, but it may be made of any Figure whatſoever that is turned upon an Axis or Poles, ſo as whereſoever the ſaid Figure be cut by a Plain to which the Axis is Perpendicular, the Superficies of the ſaid Figure ſhall deſcribe a Circle, the Center whereof is in the ſaid Axis, whether the ſaid Figure be a Cylinder Cone, or any other Conoeidical, mixt, or otherwiſe, regular, or irregular figure. Such as the Figures ABCDEFG, which repreſent the Section of the ſaid Veſſel through the Axis.

The ſecond way for the poyſing the Liquor, and keeping the Superficies thereof always to an equal height, is this:

Make a Concave Receptacle for the Oyl or Liquor of a Hemiſpherical, Semicylindrical, Semiconical, or of any other half-round hollow Figure, where the turned Figure is cut in two parts *per Axin*, and whereof the Axis is placed Horizontal, and the plain Section *per Axin* likewiſe Horizontally, ſo as it may be filled with any Liquor up to that Plain; and that the Liquor may not be apt to daſh, be ſhaken, or filter over, it will be convenient to extend the brims of that Receptacle ſomewhat above the half-Round, that there may be about half or three quarters of an Inch of ſpace above the Superficies of the Oyl vacant or empty. And that upon whatever Plain the foot ſtand, the Plain *per Axin* may ſtand Horizontal, it will be good to ſuſpend the Receptacle in the ſame manner as a Sea-mans Compaſs is ſuſpended, within a frame:

Fix

Fix this Receptacle, or the Frame that is to keep the Receptacle, Horizontal upon a convenient Pedeſtal; and fit within the Hollow or Concavity of the Receptacle a half-round ſolid poiſe, turned of the ſame form with the hollow of the Receptacle, and cut exactly through the Axis in two equal parts. Let this ſolid poiſe be made exactly half the weight of the Liquor that is to be poiſed, and fit to it two Pivots or Pins at each end of the Axis, which may be exactly in the Poles of the half-Round, and fit to thoſe Pins make two holes in the Centers of the Ends of the Concave Receptacle, in which the Pins may freely move, and ſuffer the half-Round poiſe to move round within the hollow of the Receptacle, according as the quantity of the Oyl or Liquor is increaſed or diminiſhed. Fit to this Receptacle a neck and ſocket fit for the Wick and flame of the Lamp, and the ſame operation will be performed by this as by the firſt contrivance; to wit, the Oyl will be kept always to the ſame height in the Receptacle.

This will be eaſier underſtood by explaining a Deſignation thereof which is ſhadowed forth in the fourth Figure: Where

A A A repreſents a Pedeſtal, which may be made with three claws or toes to make it ſtand the ſteadier and evenner upon any Plain or Table.

B B repreſent one of the Semicircular Arms that are fix'd to the top of the Pedeſtal, this hath two holes in it at the ends or extremities, as at C is one, the other hole being in the other arm which goes behind the Globe, and therefore cannot be ſeen, is ſuppoſed to be Diametrically oppoſite to this at C. Theſe two holes are the Center holes in which two ſmall Pins or Centers, faſtned into two oppoſite points of the Hoop or Frame are made fit to move, by which means the ſaid Hoop is preſerved in an horizontal Poſition.

D D is this Hoop or Frame, which is made to incompaſs the Veſſel or Receptacle of the Oyl, and is ſhaped exactly like it. This is made ſtrong enough of Braſs, Iron,

Iron, Silver, or other material to bear the Receptacle, Poiſe and Oyl without bending, and hath, as I ſaid before, two Pins or Gudgeons at C, and oppoſite to it Diametrically, or Semicircularly, upon which the ſaid Hoop always hangeth Horizontally. It hath alſo on each ſide in the middle between the aforeſaid Pivots, two Centers as at F and E to receive the ends of the Axis of the Receptacle appearing at F and E, by which the ſaid Receptacle is always free to hang plumb or in its Perpendicularity, ſo as that the upper edge thereof at F F will always lie Horizontally.

One of theſe Pivots, namely, that on the Right hand is the Pipe to convey the Oyl to the Socket of the Lamp I, in which is fitted a Wick of Cotton to ſerve for the flame, K G G repreſents the Veſſel or Receptacle of Oyl, which is here deſcribed Hemiſpherical, that being the moſt capacious uniform Figure, but may be of any other, qualified as thoſe I mentioned in the firſt contrivance. The Brims of this are extended ſomewhat higher than a Semicircle, namely, to F F, to keep the Oyl from flaſhing or filtring over. This is always kept full with Oyl or other Liquor to the Horizontal prick'd Line L L, which paſſeth through the Center or Axis of its Cavity by the Counterpoiſe moved on the Center C.

H H H repreſents that Counterpoiſe which is made exactly half the weight of the Oyl or Liquor, and the Center of gravity of it muſt be ſomewhere in the Line M M; and it ought to be fitted as exactly into the hollow of the Receptacle as it is poſſible, that there may be left as little ſpace as may be between its convex ſides and the Concave of the Receptacle, but yet ſo much muſt be left that it may move very freely upon its Center C a whole Semicircle. This done, and the Receptacle being filled with Oyl, the ſame effect will follow as in the firſt contrivance, and the Demonſtration of it being much the ſame, I ſhall not now ſpend time to explain it. But rather proceed to the deſcription of a third way of keeping the Liquor counterpoiſed to the ſame level.

The

The third way then is:

Take any round Veſſel, whoſe Concavity and Convexity is turned upon an Axis, and ſuſpend that Veſſel upon two ſmall Pivots (but yet big enough to bear the ſaid Veſſel filled with Oyl, *&c.*) faſtned in the Poles of that Axis; and leave or cut open a ſixth part more or leſs as you pleaſe of the ſide thereof, that thereby any thing may be put into or taken out of the Cavity of the Veſſel; then poiſe the Veſſel exactly on thoſe Centers, that no ſide be heavier than the other; then fit into it a float of Braſs, Silver, Tin, Lead, *&c.* Convex on the under ſide, ſo as juſt to fill to the Cavity of the Veſſel. And on the upper ſide, Plain, or Convex, or any other convenient Figure, it matters not much. Make this float as heavy as you can at the bottom, and as light as may be at the top, but yet of ſuch weight as may well float upon the top of the Oyl, *&c.* Let one end of this be faſtned by a wire or ſtring, ſo as that end thereof may always touch that point of the Concave of the Veſſel to which it is tied, and that the reſt thereof may turn and follow the ſinking of the Oyl; and through the end of it, near the place where it is faſtned, let a Pipe go through it to receive the Wick, which Pipe hath no communication with the Cavity of the hollow float. This done, fill the Veſſel as full as convenient with Oyl, and light the Wick, and you ſhall find that as the fire conſumeth the Oyl, the Veſſel will turn upon its Poles and keep the Superficies of the Oyl always at the ſame diſtance from the flame that it was put at at firſt till the whole be conſumed.

This will be made more conceivable by a figure and explanation thereof, which therefore take as follows in the fifth figure.

A C B B repreſents a hollow Veſſel, the Cavity whereof is very exactly turned upon an Axis whoſe Poles are in P, the ſpace between A and B in the ſide thereof is left open into the Cavity of it. This Veſſel is ſuſpended

upon its Poles at P, ſo as to be free to move round upon them, and exactly poiſed as no one ſide thereof be heavier than another. To the hollow of this Veſſel is fitted a float D of Braſs, Latton, Silver, Lead, &c. whoſe underſide is made of a Convexity juſt fit for the Concavity of the Veſſel, as may be ſeen at K D I, and the upper ſtraight or Plain. Let this float be made ſomewhat lighter than the Oyl or Liquor on which it is to ſwim, ſo that a part thereof may float above the Superficies thereof. Let one end thereof E be faſtned to the ſide of the Veſſel a little below the Brim B; through the end of this float is put a Pipe and Wick h, for the flame i, then pouring in Oyl by the open ſide A Q B, fill the ſame till it carry the float up to touch the hollow of the Veſſel; then light the Wick, and you will find that the Lamp will conſume the Oyl, and this contrivance will continually ſupply it till the whole be conſumed, and the Poiſe be moved to touch the Concave of the aforeſaid Veſſel; for when the Veſſel is filled up to f g, the float D will touch at O and E, and the Cavity above f g being empty, the Veſſel will be as is deſcribed in the Figure, the open part A B being upwards. And as the flame conſumeth the Oyl, the ſide of the Veſſel B will deſcend downward towards B 1; and ſo by B 1, B 2, B 3, to B 4, where the whole quantity of Oyl will be conſumed, and the bottom of the float will touch the hollow ſide of the Veſſel; in all which gradual waſting of the Oyl the Superficies thereof will lie at the ſame diſtance below the upper ſide of the float D that it had at firſt, and conſequently at the ſame diſtance from the bottom of the flame. The reaſon of all which will be very eaſie to be underſtood by any one that ſhall ſeriouſly on this Delineation conſider that the float D muſt neceſſitate the Veſſel A C B to move on its Axis B according as its Oyl waſts, becauſe one end thereof E being faſtned to the brim of the Veſſel B, the other end O being looſe will as the Oyl waſts deſcend towards N, whence the end E muſt hang heavier on the brim B, and conſequently muſt move it down towards B, till the upper

ſide

ſide f g of the float be reduced to a Paralleliſm with the Superficies of the remaining Oyl, and the end E have no gravitation on the brim B, which motion will be continued as the Oyl waſts, and the brim B will be moved downwards by the points B 1, B 2, B 3, to B 4. I ſhall not therefore ſpend any more time in the Geometrical demonſtration thereof, but proceed to explain a fourth way by which the Flame and Superficies of the Oyl keep always at the diſtance they were firſt put at.

The Fourth way then is, the making the Socket of the Wick to ſwim upon the top of the Oyl, ſo that the Socket may ſink as well as the Oyl, by reaſon it is ſuſtained by that, and by that only. The Veſſel or Receptacle is generally made of Glaſs, and it is beſt of a Hemiſpherical Figure, the light caſting it ſelf through the body of the Oyl as well as of the Glaſs. This is ſo plain and obvious, and ſo commonly uſed and practiſed, that I need not ſpend more time in the explanation or demonſtration thereof, but proceed to deſcribe a Fifth way.

The Fifth way then is much upon the ſame principle with the Fourth, but avoids ſeveral inconveniences to which that is ſubject: For whereas the Flame in the Fourth is neceſſitated to be within the capacity or the Receptacle in this Fifth, it may be at any diſtance, and ſo is made much more convenient to be come at, and to be dreſſed and trimmed. Take then a Veſſel of Glaſs, Cylindrical is beſt, as a Glaſs Bottle, and fit to it a Siphon, long enough to draw the Oyl from the bottom of the ſaid Veſſel, make the one end of this Siphon extend at what diſtance you think convenient for the placing the flame of the Lamp, and ſo order it that it may always draw from the Receptacle by its arms to feed the flame, which it will do if the end of the Siphon be made where the Socket of the Lamp is placed to return or bend upwards again. So that the Plain of the upper Superficies of the Oyl may cut that end of the Siphon where the flame is

between the top of the mouth of it next the Socket and the return thereof upwards; then by a counterpoiſe ſo ſuſpend this Siphon that it may follow the Oyl as it waſts, and fit into the return of the Siphon a Socket and Wick for the flame to be continued. A contrivance ſomewhat of this kind you have in divers Authors, and therefore I ſhall ſpend leſs time in the deſcription thereof. Let A A A A in the Sixth Figure then repreſent a large Cylindrical Viol of Glaſs through the mouth B of which the Cavity thereof may be filled with Oyl, and alſo the end D and float C of a convenient Siphon may be put in. This Siphon D D D P G muſt be made long enough that the float C may reach the bottom of the Veſſel when the Oyl is ſpent, and the other end thereof muſt be ſo curved that the knee of the Siphon P may be below the Superficies of the Oyl E F, and yet that the Socket H made for holding the Wick for the flame I may be ſomewhat above it, this Siphon D D D P G with its Socket and float ſhould be ſo counterpoiſed with a weight M, hung over a Pulley K, by a ſtring L, that the float may not ſink deep into the Surface of the Liquor, but ſwim as it were at the top. This done, if the Wick I be lighted, the Surface of the Oyl will be kept always at the ſame diſtance below the flame that it was firſt put at.

In the firſt, third, fourth, and fifth ways the flame of the Lamp deſcends equal ſpaces with the Superficies of the Oyl in the Veſſel, and therefore though for ſome uſes it be very convenient, as in annealings, where things are to be cooled by degrees, yet for many other it is not; Eſpecially in Lamp Furnaces, where the ſame heat is to be continued, and in ſome caſes gradually increaſed. For ſuch caſes therefore the firſt and ſecond ways will be very convenient. In ſome other caſes the ſixth and ſeventh ways, which do much the ſame thing.

The ſixth way then is this: Through an arm or Siphon (like the Branch of a Lamp hung againſt a Wall) fixed in any convenient place, the Oyl from the Receptacle is

continually.

continually and equally ſupplied to the flame of the Lamp by the raiſing of the Receptacle as faſt as the Oyl waſts, ſo as to keep the Superficies of the Oyl alway in the ſame Horizontal Plain. The Receptacle is raiſed by a Counterpoiſe hung upon a Fuſey, which Fuſey is a part of an Archimedean Spiral.

Let C C then in the ſeventh Figure repreſent the Receptacle for the Oyl, being a Cylindrical or Priſmatical Veſſel, of what Bigneſs or Length you pleaſe; to this by two Ears at L L faſten two Lines or Ropes K K, the ends of both which are faſtned to the Wheel or Pulley G, though one of them do run over the Pulley F. Fit into this Receptacle is made a Cylindrical or Priſmatical Plug A A, which is fixed in ſome convenient place, ſo as not to riſe or ſink, and through the middle thereof paſſeth a Siphon B B B, the one end whereof extended like the branch of a Candle or Lamp ſuſtains the Socket D for the Flame E, which is fed with Oyl through the Siphon B B B by the riſing Receptacle C C.

To the ſide of the Pulley G is faſtned a Fuſey H, made with very great care of one Revolution of an Archimedean Spiral, not beginning from the Center, but from ſome convenient diſtance from it, where the weight I hanging, may juſt counterpoiſe the Receptacle C C, when quite empty of Oyl, the other hanging counterpoiſe (Tangent to the largeſt part of this Spiral) muſt be ſo far diſtant from the Center of the Wheel G, that the ſame weight I may juſt counterpoiſe the ſaid Receptacle filled top-full of Oyl, and the Fuſey muſt be filed true to a Spiral, drawn with great care of one Revolution between thoſe two points. I ſay here of one Revolution, becauſe I have ſuppoſed the Wheel or Pulley G big enough, by one Revolution of it to draw up the Receptacle the whole ſpace it is to be raiſed; for if the ſaid Pulley be ſo ſmall as to require two, three, four, or more Revolutions, then muſt the piece of the Spiral between thoſe points be drawn of two, three, four, or more Revolutions proportionably, which being

being very Artificially and Mechanically performed, the Receptacle C C will be raiſed by the ſame Degrees by which the Oyl is conſumed at E, and the upper Superficies thereof ſhall always be in the ſame Horizontal Line MM. The Geometrical and Mechanical Reaſon of which being ſo very plain, I hope I ſhall not need to ſpend any more time in the explication thereof than only to ſay, that by means of the Archimedean Spiral-Fuſey the Power of the weight I upon the Pulley G decreaſeth in the ſame proportion as the weight of the Oyl in the Receptacle C C is diminiſhed by its conſumption.

The ſeventh way then is, by a Cylindrical or Priſmatical Plug fitted into a Cylindrical or Priſmatical Receptacle, and let down into it by a Counterpoiſe, hung upon a Spiral Fuſey, the Oyl is ſo raiſed in that Receptacle as always to ſtand Brimfull, or to the ſame Horizontal height till the whole Oyl be conſumed.

The contrivance of this way will be very eaſily underſtood by any one that ſhall peruſe the Delineation in the eighth Figure, and examine it by this following deſcription.

Let A A in the eighth Figure then repreſent a Cylindrical or Priſmatical Receptacle, ſtanding fixt upon a Table or Pedeſtal, from the ſide of which iſſues a hollow Arm or Branch B B, bearing the Socket for the Wick C, where the flame D is continued. Into the Cavity of this Receptacle is fitted a Cylindrical or Priſmatical Plug E E, big enough to fill the whole capacity thereof, and yet not ſo cloſe but that it may freely ſlip up and down the Cavity of the ſaid Receptacle without ſinking. Let this Plug be made conſiderably heavier than the Oyl of the Receptacle; that is, let the Counterpoiſe L, hanging upon the little Wheel M juſt reduce its gravity to be equal to that of the Oyl; then let the point I, where the Perpendicular toucheth the Spiral, be ſo far removed from the Center of the Wheel H, that the counterpoiſe

terpoiſe L may juſt take off its whole gravity, and ſuffer it to have no degree of gravity or preſſure downwards. Then draw the Spiral n o p according to the direction I gave in the former way, and the effect will be produced. The Geometrical and Mechanical Demonſtration of which is very plain to any one that ſhall conſider, that, As the Plug E E by ſinking into the Receptacle A A ſo far as to raiſe the Oyl to the Horizontal Superficies M M will loſe its gravity by the ſame Degrees by which it ſinketh into the Receptacle, and that is alway proportionable to the diminiſhing of the Oyl in the Receptacle by the flame: So the weight L will loſe its power upon the Wheel H, by the ſame degrees by which the Plug deſcendeth, by reaſon the Line by which it is ſuſpended becomes a Tangent to a proportionately ſhorter Radius of the Spiral, of the Rays of the Spiral.

I know indeed that both in this and the former Fuſey there lies an objection againſt the true form of the Spiral, becauſe the Line K K of the weight L doth not touch the Spiral in a point level with the Center, but in one ſomewhat above it, and in this latter ſomewhat beneath it; but though that be a ſeeming material one, yet as to practice it ſignifies very little. For firſt, it will not be difficult to prove that this may be Mechanically drawn true enough, that there ſhall be no ſenſible error, and if the error be not ſenſible, it is no error in practical Mechanicks. Next, were it the true Spiral, yet it would not be more Geometrically Delineated than this which is here required, and at beſt it would prove but a Mechanical approach, which is ſufficient for the effect to be produced by it.

Theſe two laſt contrivances do keep the flame of the Lamp always in the ſame place, and of the ſame ſtrength and fulneſs. But the ſucceeding ways, though they maintain the flame in the ſame degree of ſtrength and nouriſhment, yet by their motion upwards they may be made to increaſe, and intend the heat produced by them in the bodies poſited above them, which is of great

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uſe in many Chymical and Philoſophical Experiments.

The eighth way then is this: Make a Cylindrical or Priſmatical Receptacle for the Oyl exactly like the former, with its Arm, Socket, Wick, *&c.* and fit into it a Cylindrical or Priſmatical Plug, as in the former, that may be able to fill the ſaid Receptacle. Fix this Plug faſt into ſome Wall or Standard, ſo that it ſhall not be able to ſtir; Then by the help of two Lines faſtned to a Counterpoiſe at one end, and the other to the Ears of the Receptacle, ſo counterpoiſe the ſaid Receptacle that it ſhall have no weight or gravity downwards, but hang in a perfect equilibrium; I ſay, whatever quantity of Oyl there be in the ſaid Veſſel, the Superficies thereof ſhall always be in the Plain which is equal to the top of the Oyl when the Veſſel is filled as high as is deſired, which will very plainly appear to any one that ſhall examine and conſider well this following deſcription, and compare it with the Delineation of the Inſtrument in the ninth Figure, where A A repreſents a Receptacle for the Oyl of any convenient capacity, made Cylindrical or Priſmatical, to which is faſtned a hollow Neck or Arm B B for bearing the Socket C, to which through its Cavity (being made hollow) is conveyed the Oyl or *Pabulum* for the continuance of the Flame D; into this Receptacle fit a Cylindrical or Priſmatical Plug, ſo as it may pretty equally fill the ſaid Cavity of the Receptacle, yet not ſo as any ways to hinder the ſliding on upon it of the Receptacle. Let this Plug then be fixt by the top in any convenient place Perpendicularly, and ſetting the Receptacle underneath it, Counterpoiſe the ſame when filled up with Oyl by a Counterpoiſe I, which is faſtned to the two ſtrings F F F F, by which the Receptacle is to hang, which two ſtrings for their more eaſie ſliding to and fro move upon the two Pulleys or Truckles G G, that are fixed to the ſame frame to which the Plug E E is fixed; which being ſo adjuſted, as faſt as the flame D conſumeth the Oyl out of the Receptacle A A, the Counter-

Counterpoiſe I raiſeth the ſaid Receptacle on upon the Plug ſo far till the top of the Oyl be equal to the height it was at firſt counterpoiſed at, to which height it always keeps it till the whole be conſumed.

This laſt way of poiſing the Liquor or Oyl doth make the Superficies thereof run higher and higher as the quantity thereof is more and more conſumed, which for divers Expedients in Mechanicks, Natural Philoſophy, and Chymiſtry is of excellent uſe, as I may hereafter have opportunity to manifeſt upon many occaſions where I ſhall make uſe of them; and it would be, I fear, too tedious to the Reader to have them here enumerated.

But becauſe it may not poſſibly be ungrateful to him to have ſome uſes of this Principle here hinted, I ſhall now ſpecifie a few, and hereafter add many more, together with a great number of other Poiſes for Liquors which ſerve for very differing effects in their kinds, not leſs conſiderable, but rather ſomewhat more ſtrange, as being yet farther removed from the common practices and diſcourſes of Hydraulicks.

The firſt uſe then that I ſhall mention of this Liquor-poiſe ſhall be in Hydraulicks, *viz.* to make a Ciſtern of whatever bigneſs and depth is required to deliver all its water at the top, or ſo near unto it as it ſhall be deſired: By which means nothing of the Deſcent of the water falling into the Ciſtern is loſt, but without any labour or trouble the whole quantity of water that is delivered at the top into the Ciſtern is re-delivered again out of the Ciſtern at the top. This may be done by the firſt, ſecond, and ſeventh ways of poiſing Liquors; this, that, or the other, of which may be more convenient to this, that, or another effect or operation to be performed by it, which muſt be choſen and applied with judgment, according to the occaſion, and the circumſtances of it. Every of the three, though they all agree together in the producing the effect of keeping the Su-

perficies of the water to the same Level, and there delivering it, have yet each of them their several properties, which maketh some one of the three more proper and adapted to one design than either of the other two, and each of the other two in some other effects and applications may be much more usefully applied than the first. By this means the whole depth of the Cistern is gained, and all that water that was used to be delivered at the bottom is now delivered at the top, and consequently gains the advantage of the Perpendicular height of the Cistern to be imployed, for any use, for turning an Automaton, or conveying the Stream further, or to a higher level.

A second effect performable by these Poises may be for delivering any quantity of water with an equal degree of swiftness, so as to continue an equal supply of water till the whole Cistern or Receptacle be emptied, the spending of the water in the Cistern not at all abating the stream without, the Counterpoise always keeping the Cistern full, and maintaining the current till the last. This may be useful for sawing or grinding stones by an Engine; for gauging of Glass Tools, or grinding glasses by an Automaton, in all which cases there is need of a constant and equal supply of water and sand; as also for washing and Fulling of Cloth; it may also serve for various sorts of Clepsydras, or measuring the quantity of time by the quantity of the current of water, as I shall by and by shew. And thirdly, for maintaining any slow and constant motion, as that of a Jack, or Clock; an Engine for continually stirring of a liquid body, or shaking, tumbling, and turning of dry Solids and powders, of which sort there are a great number of uses in Chymistry for the operations of Digestion, Calcination, Pounding, Grinding, Trituration, Searcing, and the like; which operations being certainly, evenly, and constantly performed by an Engine supplied by such a stream of water will far exceed the same kind

of work done by the hands of men, especially in such operations where the Labour and Diligence is to last divers days and nights together without any intermission, which are Requisites not at all strange to Chymistry, and which will weary the diligence of the best Laborant and his Attendants.

A third effect performable by these Poises is the making a perpetual and constant stream in imitation of that of a natural Spring or Fountain in the Earth. This may be done if the Cistern be once in twenty four hours recruted and supplied with a new access of water from some Pipes, which is usual enough here in *London*, and elsewhere, where there are Waterworks and Conveyances of water. For as the wasting of the water in the Cistern does no ways abate or diminish the stream of the water from the Cistern, so the new access of other water for a supply to refill the Cistern does not at all accelerate it, but the stream remains equal; And hence, consequently constant, and, as it were, perpetual.

A fourth effect is, the delivering any quantity of water to any degree of swiftness, and the whole quantity of the water by the same degree. This is performed by tapping the Cistern at any part of the depth thereof, for according as the Vessel is tapp'd lower under the Surface, so will the motion of the water be swifter; and here the depths must be in a duplicate proportion to the Velocity desired: As for instance, the Cistern being tapped with a hole of a quarter of an Inch bore, at the depth of an Inch below the Surface, is found to deliver a certain quantity of water in a minute; if it be desired that through a Tap of the same bore there should be delivered twice that quantity, the Cistern must be tapp'd at four Inches deep; and if thrice that quantity in the same time, it must be tapp'd at nine Inches deep; and so forwards, as is already demonstrated by *Mersennus*, and other Authors. For since the pressure of Fluids upon the parts thereof increase, in the same proportion

with the depth below the Surface. And since the forces requisite to accelerate motions must always be in duplicate proportion to the Accelerations, it follows, that the perpendicular depths of the Tap under the Superficies of the water must be always in duplicate proportion to the Velocities required.

The plainness and certainty of this truth in Hydrostaticks, long since so fully and excellently demonstrated by *Stevinus* of all Fluids, and so highly improved of late in the particular applications thereof by many more modern Authors, who have writ most learnedly and clearly thereof, as well as experimentally and practically, makes me much admire at the learned Doctor *More*, who in his *Enchiridion Metaphysicum*, in the 11, 12, and 13 Chapters, and in a Book, newly published, called, *Remarks upon two late ingenious discourses*, &c. does not only deny this Gravitation in the parts of Air, but of Water, quicksilver, and other Liquors. And instead thereof, to solve the Phenomena, would introduce into the World a Principle, which he terms an *Hylarchick Spirit*, which at command acts and performs whatsoever is necessary to solve all the Phenomena of Mechanical, Hydrostatical and in a word, all Physical motions and effects.

In answer to whose Doctrine about Hydrostaticks I shall only urge this one Experiment of the Velocity of the current of Fluids, tapp'd and running at several depths under the Superficies of that Fluid, which can no ways be solved by the Hylarchick Spirit, and we must be fain to come to the Mechanical and plain Rules of motion, and to allow every particular of that Fluid to press with its own gravity where ever placed. And this I will prove from his own words in his *Enchiridion Metaphysicum*, pag. 113. where explaining very ingeniously the Hypothesis of Gravitation of the parts of Fluids one upon another by the similitude of six men standing in a Line, and pressing against a Wall, (which men he marks with A B C D E F, and the Wall with G) He says, that A the first man cannot press F the last against the Wall

G, but by preſſing B againſt C, and C againſt D, and D againſt E, and E againſt F; nor can A preſs B againſt C, nor C preſs D againſt E, nor E preſs F againſt the Wall G, but at the ſame time it muſt be underſtood that B preſſes D towards F, and D preſſes F towards the Wall G, for A C and E, ſays he, are here put for *Des Cartes Materia Cœleſtis*, preſſing the parts of the water within the pores, and B D and F for thoſe parts of the water preſſing the bottom of the Veſſel. But, ſays he, that B preſſes D, and D preſſes F appears from this, that caſting out E and F, D doth run to the Wall G, and caſting out C D E and F, B alſo will run to the ſaid Wall. And ſo, ſays he, the ſtate of the matter would be if Gravity did proceed from the meer Mechanical motion imparted to the Terreſtrial parts of the Fluid by the *Materia Cœleſtis* of *Des Cartes*, to wit, the Elements would actually gravitate in their proper places. But ſince there is no ſuch thing, it is a ſure ſign that Gravity doth ariſe from a higher cauſe, which higher cauſe he elſewhere ſuppoſes to be an Hylarchick Spirit. This from ſo plain reaſoning is a ſtrange Concluſion, and contrary to all experience.

Now though, I confeſs, I ſuppoſe Gravity to be otherwiſe performed than as *Des Cartes* has ſuppoſed, yet do I believe his Suppoſitions ſo Rational and Ingenious, and ſo much above the Objections brought againſt them, and ſo much better than any other I have yet met with, as no wiſe to deſerve to be eſteemed *fœda deliria*, as the learned Doctor is pleaſed to term them, *pag.* 125.

It ſhall not be my buſineſs to defend *Des Cartes* Principles at the preſent, nor to ſet up any new Hypotheſis inſtead thereof, but only to urge this Experiment of the running of a Liquor ſwifter and ſwifter, according as the hole through which it runs is deeper and deeper placed below the Surface of the ſaid Liquor or Fluid, and that the Velocities of thoſe ſtreams are always in a ſubduple proportion to the Altitude of the Fluid above thoſe holes; whence it is evident, that the force that makes that Fluid run is always in the ſame proportion

with

with the Altitude of the fluid parts above thoſe holes; and conſequently, that the motion of them is exactly according to the plain and obvious Rules of Mechanical motions. And conſequently for the ſolving all the Phenomena of Hydroſtaticks there is no need of any other Principles than the plain Mechanical Principles, which ſuppoſeth every Terreſtrial Body to have a Gravity in it, which is always the ſame, and always communicates its Gravity to the Terreſtrial Bodies ſubjected under it, and not only its own, but the Gravity of all other Bodies above it, which have communicated their Gravity to it, and that this Gravitation is always the ſame, and acteth continually by continual repetitions indefinitely ſwift. And that this gravitating or communicating of its weight, together with the weight of all other Bodies communicated to it, is no ways differing from all other communications or propagations of motion, which the Doctor muſt confeſs to be meerly Mechanical, if at leaſt he will admit of any ſuch thing as Mechanical motion. For I cannot conceive any Reaſon why the Doctor ſhould not allow for inſtance the parts of a Cylinder of Lead to preſs upon one another as much when they are kept melted in an Iron Cylinder into a Cylindrical form part over part as when the Lead is cold and divided into ſeveral parts, and laid one over another in the ſame form that they were kept in by the incompaſſing Iron Cylinder. Since if the Iron Cylinder and melted Lead, and the Iron Cylinder and cold Lead be weighed, it will be found that they have both the ſame weight or gravity downwards, and do communicate continually the ſame force, preſſure, indeavour, impetus, ſtrength, gravity, power, motion, or whatever elſe you will call it to the Scale. And I ſuppoſe the Doctor will grant, that if the cold Cylinder of Lead, weighing ten pounds, be divided into ten ſhorter Cylinders, that are each a tenth part of the whole, and do each weigh a pound alone, every one of the upper ſhall gravitate upon every one of the lower; and that the tenth, with the other nine

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upon it, ſhall preſs the Scale with ten pound weight; and conſequently, that the tenth doth not only communicate its own gravity of one pound, but the gravity of all the other nine above it, which is nine pounds; and, if the tenth be taken away, and the ninth be put to touch the Scale, with the other eight upon it, it is certain that the ninth will not only communicate its motion, or preſs the Scale with its own weight of a pound, but will communicate the motion to, or preſs the Scale with the weight of eight pounds more, or of all the eight Cylinders ſuperincumbent, and the like Ratiocination may be upon the eighth, ſeventh, ſixth, fifth, fourth, and ſecond, but the laſt will only preſs the Scale with its own weight, unleſs we take in the conſideration of the weight of the Air, which in this Ratiocination is not neceſſary. Since then I think it cannot be denied but that the whole ten ſtanding in a Cylinder one over another, the tenth is preſſed by nine, and preſſes with ten pound weight; the ninth preſſes with nine, and is preſſed with eight; the eighth is preſſed with ſeven, and preſſes with eight, and ſo onwards, and that the preſſure of the loweſt downward is always proportionable to the height of this Cylinder. Suppoſing theſe to be all melted in an Iron Cylinder, but kept in the ſame poſition and ſituation, and finding the whole to keep the ſame weight, why ſhould we not believe that each of thoſe parts will exert the ſame effects, as to gravity, on thoſe beneath it as the ſame parts cold, and in the ſame poſture did; ſince if the Cylinder of the Fluid be ſhortned by 1, 2, 3, or 4, tenths of its height, the ſame abatement of weight or gravity will appear. Having ſeriouſly peruſed all the Ratiocination that the Doctor hath produced, both in this late Book, and in his *Enchiridion Metaphyſicum*, I cannot find any convincing reaſon againſt it, but what ſeems grounded upon ſome pre-conceived Notions and Hypotheſes which I cannot underſtand; and I cannot ſee how he can avoid acknowledging this to be a Mechanical motion, if at leaſt he will allow any Mechanical

chanical motion at all, since it doth so perfectly, and in all circumstances so exactly conform and agree with the Laws of Mechanical motion, that I do not know any difference, nor any one Phenomenon of Hydrostaticks or Gravity but what may be clearly solved by the common Rules of Mechanicks.

But to pass by all other Mediums to prove this Gravitation or pressure of the parts of Fluids one upon another, I shall only insist upon this one Experiment of the Velocity of Fluids, vented or running at several depths below the Superficies of that Fluid. In which it is observable, that the quantity of water running within a certain space of time is always in a Subduple proportion to the height of the pressing Fluid above the hole. That is, the quantities of water are in proportion to one another as the square Roots of the several Altitudes. As for instance, it is the observation of *Mersennus* in his Hydraulicks, that a Tap of an Inch bore, four foot under the Superficies of the water will yield a pound or pint of water in 13 Seconds of time; now, if it be desired to make the water run through a Tap of the same bore twice as fast, that is, to yeild a quart or two pounds of water. This new Altitude must be made to the former Altitude, as the square of two to the square of one, that is, as four to one; whence it will follow, that the Altitude of the water above the Tap must be made sixteen foot to make the Tap run a quart of water in 13 Seconds of time. And if it be desired to have the Tap run a Gallon or eight pints in 13 Seconds, the proportion of the new Altitude to the first must be as the square of eight to the square of one, that is, as 64 to 1, whence the Altitude of the water must be 256 foot, and the like for any other quantity or Velocity desired. As if it be desired that the Tap should only run half a pint in 13 Seconds, the Tap must be placed at one foot under the Superficies, which is a quarter of the former Altitude. Now this is exactly according to the General Rule of Mechanicks. Which is, that the proportion of

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the ſtrength or power of moving any Body is always in a duplicate proportion of the Velocity it receives from it; that is, if any Body whatſoever be moved with one degree of Velocity, by a determinate quantity of ſtrength, that body will require four times that ſtrength to be moved twice as faſt, and nine times the ſtrength to be moved thrice as faſt, and ſixteen times the ſtrength to be moved four times as faſt, and ſo forwards. This is moſt certainly true in the motion of Bullets ſhot out of Cannons, Muskets, Piſtols, Wind-guns, Croſs-bows, Spitting-Trunks, and the like; as likewiſe in the motion of Arrows ſhot with Bows or Balliſtæ; of Stones thrown by the hand, or with Slings; of Pendulums moved by Gravity or Weights; of Muſical Strings; of Springs, and all other vibrating Bodies; of the motion of Wheels, Flies, *&c.* drawn and turned by Weights or Springs; of the motion of Perpendicularly or Obliquely falling Bodies; and in a word, of all other Mechanical and Local motions, allowance only being made for the impediment of the Air or other Fluid Medium, through which the Body is moved. Now if the Doctor will contend for an Hylarchick Spirit to perform all theſe, he may plauſibly enough contend for it alſo in the Experiment of the Gravitation of the parts of Fluids one upon another.

We ſee then how needleſs it is to have recourſe to an Hylarchick Spirit to perform all thoſe things which are plainly and clearly performed by the common and known Rules of Mechanicks, which are eaſily to be underſtood, and imagined, and are moſt obvious and clear to ſenſe, and do not perplex our minds with unintelligible Idea's of things, which do no ways tend to knowledge and practice, but end in amazement and confuſion.

For ſuppoſing the Doctor had proved there were ſuch an Hylarchick Spirit, what were we the better or the wiſer unleſs we alſo know how to rule and govern this Spirit? And that we could, like Conjurers, command this Spirit, and ſet it at work upon whatever we had occa-

ſion for it to do. If it were a Spirit that Regulated the motion of the water in its running faſter or ſlower, I am yet to learn by what Charm or Incantation I ſhould be able to incite the Spirit to be leſs or more active, in ſuch proportion as I had occaſion for, and deſired; how ſhould I ſignifie to it that I had occaſion for a current of water that ſhould run eight Gallons in a minute through a hole of an Inch bore? If the Doctor ſhould tell me, that I muſt make the Tap at ſuch a depth under the Superficies of the water, and then the Hylarchick Spirit will make the water run as I deſire, I would then inquire how he comes to call that an Hylarchick, or matter-governing Spirit, which is rather commanded by matter, and ſubjected to its Laws, and is neceſſitated to act exactly according to the quantity and poſition of matter, by what means ſoever it be ſo placed? This Principle therefore at beſt tends to nothing but the diſcouraging Induſtry from ſearching into, and finding out the true cauſes of the Phenomena of Nature: And incourages Ignorance and Superſtition by perſwading nothing more can be known, and that the Spirit will do what it pleaſes. For if all things be done by an Hylarchick Spirit, that is, I know not what, and to be found I know not when or where, and acts all things I know not how, what ſhould ſhould I trouble my ſelf to enquire into that which is never to be underſtood, and is beyond the reach of my Faculties to comprehend? Whereas on the other ſide, if I underſtand or am informed, that theſe Phenomena do proceed from the quantity of matter and motion, and that the regulating and ordering of them is clearly within the power and reach of mans Induſtry and Invention; I have incouragement to be ſtirring and active in this inquiry and ſcrutiny, as where I have to do with matter and motion that fall under the reach of my ſenſes, and have no need of ſuch Rarified Notions as do exceed Imagination and the plain deductions of Reaſons therefrom.

For what is clearer to be ſeen and tried by Experiment,

ment, and what more eaſie to be imagined and underſtood than that a Cylinder of water, or any other Homogeneous ſubſtance of twice the height ſhould have twice the gravity or preſſure: of thrice the height, thrice the preſſure: of ten times the height, ten times the preſſure: of 100 times the height, 100 times the preſſure, and conſequently, to imagine that as in all other Mechanical motion, four times the preſſure will double the Velocity, nine times the preſſure will treble it, ſixteen times will quadruple it, and 100 times will decuple it, and ſo forward; So in this Experiment the ſame preſſure will perform the ſame effect, and a proportionate preſſure a proportionate effect. And ſince we find that the effect does moſt exactly anſwer the Theory (as moſt certainly, evidently, and undeniably it doth) why ſhould we doubt of the cauſe which is ſo certain and Regular a Concomitant, that it is always preſent when the effect is performed? And where ever it is preſent, (if other Circumſtances hinder not) the effect certainly follows. I could have gone over all the other Ratiocinations of the Doctor for an Hylarchick Spirit to perform the effects which do clearly belong to Mechanical motions and powers, and are performed and regulated exactly according to the quantity and quality of matter, and according to the general and univerſal Laws of motion, and not otherwiſe. But that is not my preſent buſineſs, but rather to explain how this contrivance of Poiſes doth ſerve to make a Ciſtern or Veſſel to run any quantity of water required in any ſpace of time. And that to run the whole quantity either with an equal Velocity or ſtream, or by any deſired degrees to be accelerated or retarded from the beginning to the end, which for ſome occaſions in Mechanicks is of great uſe, and hath not been explained by any Writer of Hydraulicks hitherto.

I ſhould have here left this Digreſſion, but that I find a little further in the aforeſaid Doctors *Enchiridion*, to wit, in the nineteenth Chapter, in the fifth, ſixth, ſeventh,

and eighth Sections, continued from the 246. to the 256. Page, ſome Animadverſions upon an Explication of Colours which I did formerly publiſh in my *Micrographia*, from the confutation of which he endeavours to aſſert this *Hylarchick Spirit*. But in this he doth *Canere triumphum ante victoriam*, and ſeems to make very ſlight of that which he neither hath hitherto by all he hath ſaid in his *Enchiridion Metaphyſicum*, nor can by all other Arguments he can produce anſwer. For if the Doctor had pleaſed to have conſidered the Objections I made againſt the Hypotheſis of the Rotation of the *Carteſian Globuli*, with a little more ſerioufneſs and deliberation, he would not, I conceive, have believed that one that underſtood the Objection would be ſatisfied with ſo ſlight and inſignificant anſwers, as he is pleaſed to make to them. His Anſwer then to the firſt Objection which I brought againſt this Hypotheſis, which was raiſed from Experiments made with thin plated bodies, producing colours, though the refracting Superficies were parallel, is no more but this: That it is not every ſecond Refraction of the Ray in a Parallelipiped that doth deſtroy the Rotation generated by the firſt, but only that which entring at one ſide, paſſeth through, and goeth out again with the ſame refraction it entered. In which caſe only, ſays he, the Rotation of the *Globuli*, generated in the firſt Superficies, is deſtroyed in the ſecond. But, ſays he, a Ray falling upon a Parallelipiped, and being reflected from the ſecond Superficies, ſuffers a double Refraction in the ſame Superficies, the one at entring, and the other at going out again; both which Refractions, ſays he, do promote the Rotation of the *Globuli* the ſame way. This he ſays very poſitively, but gives no reaſon for it. Nor indeed could he, ſince it is expreſly contrary to *Des Cartes* Principles, and to all the Phenomena of ſuch Parallel ſided bodies until they come to a certain degree of thinneſs: For if his Affirmation were true, then muſt all Reflections from the Quickſilver, or foil of Looking-glaſſes, eſpecially if a little oblique, make the Object

ſpread,

ſpread, and become coloured in the ſame manner as Objects do which are look'd at through Priſmes. But this is contrary both to Experience, and the Laws of Reflection; for the Refractions in the Parallelipiped B are the very ſame with the Refractions in the Parallelipiped A, the Reflection at D making the Ray to be refracted at F, in the ſame manner as if it were refracted at G by G H, and the Parallelipiped were twice as thick, and conſequently the colour generated in E muſt be deſtroyed in F, and conſequently produce no colours, as really it doth not in plates beyond ſuch a thickneſs; whereas if the Refraction at F did promote the Rotation, as he affirms, then muſt the reflected Superficies I K not be Parallel to E F, but inclined to it with an Angle at L M. Then G N would repreſent F O, which is impoſſible, and contrary to the Laws of all reflection, as he might have underſtood if he had conſidered my Demonſtration about the Reflections of a Globe. Nor will the Doctors adding, *Sed de hac prima objectione non eſt quod Jnmus adeo ſoliciti, cum ſit in materia magis incerta ac inequali cujus interna contextura videatur Globulorum motus variis modis poſſe mutari.* For ſince all tranſparent bodies whatſoever produce the ſame effect, that Subterfuge of ſuppoſing ſome ſtrange inviſible texture in the body of *Muſcovy* Glaſs, differing from that of other tranſparent bodies, will prove but a lame help, for this *interna contextura* muſt be common to all tranſparent Bodies. And why it ſhould do it at one time, and not at another, the Doctor doth no where ſhew, nor ſeems to underſtand.

Next, whereas in the ſeventh Section of the ſaid nineteenth Chapter he ſays, *Verum in materia illa idonea Gutta ſcilicet Pluvia, ſi nullus Demonſtratio is Scopo ſubſit error, actum eſt de Globulis Carteſianis. Sed videtur* (ſays he) *ingenioſus demonſtrator non ſatis intellexiſſe ſcopum qua collinneare debeat ipſius Demonſtratio.* To which I anſwer, that I perceive by the Learned Doctors endeavours to refute it, that he neither underſtood that, nor the Laws of Reflection and Refraction according

to

to *Des Cartes* Hypotheſis. *Neque enim ſatis erat probare (quod agnoſco eum feciſſe ſcite & eleganter) Refractiones in gutta pluvia ita fieri, ut ſi in duobus pellucidi Parallelipipedi Lateribus oppoſitis, factæ eſſent, ſed oportebat præterea evinciſſe quod eodem modo refringatur radius in utriſque Locis quo in Parallelipipedo* A *refringitur, hoc eſt ut Radius* B C *quamvis oblique, perpetuo tamen currat verſus eandem extremitatem tam in* F *quam in* D *Parallepipedi* A *puta verſus extremitatem* E, *nam in hoc caſu Rotatio ad* D *diſſolvitur iterum ad* F *ut ſupra dictum eſt; ſed Demonſtratio Ingenioſi Micrographi huc non attingit; ſed probat ſecundam refractionem in oppoſito Latere fieri ad modum refractionis in Parallelipipedo* C *ubi Radius* B N *primo refringitur in* D *& procurrens verſus extremitatem* E *ibique inflexus pergit poſtea verſus alteram extremitatem* G *& Refringitur in* F, *quæ refractio non diluit Rotationem prioris refractionis in* D, *quippe quod tendentia Radii ſit in partem oppoſitam.* If the Learned Doctor had better conſulted *Des Cartes* Doctrine, or the common Laws of Reflection and Refraction, he would have been of quite another mind, and would not ſo poſitively have aſſerted a Propoſition ſo poſitively contrary to the Principles of *Des Cartes*, and all Experiments. For if what he affirms were ſo, then (as I urged before) according to *Des Cartes* Doctrine, and the Doctrine he would defend, the Image from a Looking-glaſs muſt be returned coloured, and the ſame alſo from a plain ſided Priſme, where the refracting ſides are Perpendicular or equally inclined, but contrary ways to the Reflecting Superficies. But this is contrary to Experiment, he muſt therefore once again conſider how to find out a Reaſon why there is no colour generated, where, according to his Aſſertion, there is ſo great a refraction, and a doubly promoted Rotation made in both the refracting Superficies the ſame way, and both ſo much promoting the ſaid Rotation of the Globuli. He might therefore, if he had pleaſed, have ſuſpended his Concluſion. *Adeo ut Doctrina Carteſiana de Globulis eorumque Rotationibus nihil periclitetur ab hac Demonſtratione*

tione quæ quamvis ſatis elegans ſit & concinna, debitum tamen ſcopum non omnino attingit, until he had a little farther conſidered the nature of Reflection and Refraction. Now, becauſe I find that the Learned Doctor is not the only perſon that hath not rightly apprehended this Theory, give me leave to explain a little more particularly the manner thereof: Suppoſe we then in the three Figures D E and F, that the ſpace between the two Parallel Lines a c and b d doth repreſent a Ray or Radiation of light; Not a Mathematical Line, but a Phyſical one of ſome Latitude, between which Lines is propagated a motion, or ſomething equivalent thereunto, which ſerves to produce the effect of light. This motion we ſuppoſe to be propagated by a Pulſe or Wave in all uncoloured Rays at Right Angles with the Line of Direction, but in coloured Rays more or leſs obliquely according to the greater or leſs refraction. We will ſuppoſe the ſtroke of the Pulſe to be the length of the ſpace between 1 and 2, or 2 and 3, or 3 and 4, *&c.* and conſequently, in a uniform medium the pulſe will continue the ſame, and the expanſion of it will be Perpendicular to the Line of Direction or progreſs; but when it comes to the Refracting Superficies c d, Obliquely the ſide of the Pulſe c touches the refracting Superficies firſt, and being propagated into the refracting medium by a longer and quicker Pulſe, it is propagated to 4 below c before the other ſide of the Pulſe touches the Superficies at d, the Pulſe therefore 4 4, 5 5, 6 6, *&c.* becomes Oblique to the tendency of the Radiation; and by the Superficies e f it is reflected by 7 7, 7 7, 7 7, till it touches the ſecond refracting Superficies g h; where it is obſervable, that the ſame ſide of the Ray that entred firſt the Superficies c d enters firſt into the Superficies g h, in the ſame manner as if it had proceeded on by the ſtraight Lines f m e l. till it met with a Parallel Superficies l m to the firſt c d; for the Ray between the two Parallel Lines f h, e g, hath the ſame inclination and reſpect to the Refracting Superficies h g, that the Ray between f m and e l would have

have to the Superficies m l, ſuppoſing there were no Reflecting Superficies at e f. I ſhall not need, I hope, more particularly to demonſtrate every part of this Explanation, the very obſerving the Delineation of the Scheme being enough to make it plain to any one never ſo little verſed in Geometry, from which he will plainly perceive that what I endeavour to demonſtrate was really ſo, and that I did underſtand what ſcope my Demonſtration aimed at, ſo far as to hit the Mark, which was to ſhew that Colours were generated, where, according to *Des Cartes* own Principles, there could be no Rotation of the Globuli. Now, though the Learned Doctor would not admit of this Demonſtration to be ſufficient to do the work, yet he ſays, *Pag.*252. *Verum tamen diſſimulandum non eſt, non pauca me meapte opera excogitaſſe quibus pro perſuaſiſſimo habeo eorum motus & rotationes modis pure mechanicis ſemper fieri non poſſe.* And in proſecution of the deſtruction of this Rotation of the Globuli, which he hath hitherto ſeemed to defend, he adds four ſeveral Arguments, I ſhall not now ſtay to repeat them. But whoſoever will pleaſe to read what the Learned Doctor hath *ſuapte opera* excogitated againſt the *Carteſian* Hypotheſis, and ſet down in the 252, 253, 254, and 255. pages. And compare them with what I have ſaid in the forementioned place, to wit, at the latter end of the 60. and the beginning of the 61. pages of my Micrographia, may plainly find the Arguments brought by the Doctor do very little, if at all, differ from thoſe I there publiſhed.

I could heartily therefore have wiſhed that the Learned Doctor had made uſe of ſome other Mediums to prove the Exiſtence of an Hylarchick Spirit, and not have medled with Arguments drawn either from Mechanicks or Opticks; for I doubt, that ſuch as underſtand thoſe ſubjects well, will plainly ſee that there is no need of any ſuch Hylarchick Spirit; and if there be no need of it, but that all the Phenomena may be done without it, then it is probable that there is none there, for

Natura

Natura nihil agit frustra. It had been much easier to have proved the existence of it by Arguments drawn from subjects we less perfectly understand, as from the generation, nutrition, vegetation, and propagating of Vegetables, and animal substances; for there the manner of the progress of Nature being infinitely more curious and abstruse, and further removed beyond the reach of our senses and understandings, one may more boldly assert strange things of this Hylarchick Spirit without fear of controul or contradiction, and from whence possibly it may never lie within the power of Reasoning to banish him.

But to leave this Digression, and return to the use of these water-poises.

A fifth effect may be for washing and refining of Earth, Clays, Powders, and the like; the clear water by these contrivances being made to run over gently at the top, and so leaving all the settlement from the water at the bottom.

By any one of these, with a receptacle Cistern added to it, the stream of water from that Cistern may be accelerated or retarded by any degrees desirable. This doth depend partly from the proportion of the Tap of the Receptacle Cistern to the Tap of the counterpoised Cistern, and partly from the shape and make of the Receptacle Cistern, by the proportion and shape of which the stream of Liquor through the Tap of the Receptacle Cistern may be modulated at pleasure, as any one, a little versed in Hydrostaticks, will easily perceive and demonstrate.

A sixth effect may be for governing the heat of Lamps for Distillations, Digestions, Fermentations, Putrefactions, Dissolutions, hatching the Eggs of Birds or Insects; accelerating, and seasoning, or timing the growth of Plants; nealing of Glasses and Metals by the gradual access of the heat, so as to make them fit for stronger

degrees, or by the gradual receſs to bring them out of the greater degrees to make them tough and capable to receive the cold of the Air.

It would be too long to give inſtances of contrivances for every of theſe operations but the skilful Mechaniſt, Philoſopher or Chymiſt will eaſily ſupply his own deſires by ſome one of theſe I have inſtanced in, or at leaſt by a compoſition of them. I ſhall therefore only add a deſcription of a Clepſydra or time-keeper or two, and ſo leave this ſubject for the preſent.

A deſcription of a new ſort of Clepſydra.

THis contrivance is nothing elſe than that Two of the ſecond ſort of Veſſels are ſo contrived as to run into each other and to empty themſelves and be filled alternately, and their bigneſs or capacity and the hole through which the Liquor is vented are ſo proportioned as to be emptying the ſpace of an hour, which is eaſie enough, and may be adjuſted to what accurateneſs is deſired. Then the convex Superficies of the Cylindrical poiſe is divided into ſixty equal parts by ſtraight Lines drawn upon its Surface Parallel to the Axis, and to each other; theſe lines by the ſinking or turning of the ſaid poiſe denote the minutes, and if ſmaller Diviſions of time be deſired, the ſpaces between them may be divided by other ſmaller Parallel Lines denoting the parts of each minute to what niceneſs is deſired. One of theſe Cylindrical Receptacles may be fixt, and the other by an eaſie *apparatus* may be made to riſe a little when it is top-full, and fall a little when quite empty below the Level of the other that is fixt: The Chanel between them, through which the water is to run out of the one into the other, may be a ſmall pipe with a hole in it of a bigneſs proportioned, as I ſaid above, to let the Liquor run out

of one into the other in the time desired, and its ends may be fastned to the two Receptacles by a part of the neck of a bladder or gut, so that it may be limber, and may always have a Declivity into the Vessel that is to be filled; the Declivity need not be above half an Inch. The Liquor used in it may be Water, Oyl, or any other Liquor that doth not easily evaporate: But the best of all is Quicksilver, because it doth not with keeping evaporate at all sensibly, which I have carefully observed for these fifteen years last past. Nor doth it grow thick or foul by the alteration of the Air, nor do I find it sensibly alter by the heat and cold, at least not comparable to the great changes which other Liquors suffer by the alterations of those qualities. It is an excellent material for measuring time in a standing Machine; and there may be hundred of ways contrived to make it measure the space thereof as accurately as a Pendulum; and I have many times admired that *Tycho Brahe*, who was otherwise so curious and exact in the contrivance and make of his Engines and Instruments, was yet so defective in his contrivances of measuring time by Quicksilver, when there were so many obvious and easie ways of doing it, as he seems to complain in his works. I have made trial of several with very good success, and found some of them even beyond expectation certain, of which I may hereafter upon an other occasion add the descriptions, when I publish the various ways of making exact Time-keepers or Watches. In the mean time, being now speaking of Time-keepers, for variety sake I shall mention.

A New Principle for Watches.

THis is a way of regulating both standing Watches, and movable Watches, either for the Sea, or the Pocket, which some ten or twelve years since I shewed the *Royal Society*, when I shewed them my contrivances of the Circu-

lar Pendulum, which is since published by Monsieur *Hugenius*, which is also mentioned in the History of the said *Society*, p. 247. lin. 20. This was by a fly moving Circularly instead of a ballance, whose motion was regulated by weights, flying further and further from the Center according as the strength of the Spring of the Watch had more and more force upon its Arbor. The Weights were regulated from flying out further than they ought to do by the contrivance of a Spiral Spring, drawing both the said Weights to the Center of the motion or fly, in the same proportion as I then demonstrated Gravity to attract the weight of a Circular Pendulum, moved in a Parabolical Superficies, towards the Center or Axis of its motion. The Weights were so contrived as always to counterpoise each other. The Skeleton of this fly you have represented in the Figure. The particular explanation of the parts, and the Geometrical Demonstration of the Principle both of the Springs, and of the flying from the Center, I shall explain in the Theory of Springs, and in the description of Time-keepers and Watches.

Οἱ δημιουργοὶ κατασκευάζουσιν ὄργανον κρύπτοντες τὴν ἀρχὴν, ὅπως ἢ τοῦ μηχανήματος φανερὸν μόνον τὸ θαυμαστὸν, τὸ δ' αἴτιον, ἄδηλον. *Arist. Quæst. Mechan.*

An Observation about the Seed of Moss.

SInce the publishing of my Micrography, I have met with an Observation, which though it be of one of the smallest compound bodies I have hitherto taken notice of, yet does it afford a hint of very great concern in Natural Philosophy; And it does seem to make clear the cause of a Phænomenon, that hath appeared dubious, not only to me, but to many other more knowing Naturalists. I have often doubted, I confess, whether Moss, Mushroms, and several other small Plants (which the Earth seems to produce

duce ἀυτομάτως) were the off-spring of a Seed or Grain; and I have been apt to believe, that they were rather a ſecondary production of Nature; being ſomewhat the more inclined to that opinion, becauſe having formerly examined the ſmall knots or Seed-cods of Moſs with a ſingle Microſcope, I could not perceive any thing in them that I could imagine to be Seed, at leaſt not ſo great a quantity as ſeemed neceſſary to maintain ſo numerous a Progeny, as was every where to be found of it; that, which then came out of them, ſeeming to be rather a pulp or pith, than any thing like the Seeds in other ſimilar Cods. But being ſince ſomewhat more inquiſitive, I did examine ſeveral of the above-mentioned Knobs or Seed-veſſels, and found that there were ſeeds in them, no leſs wonderful for the greatneſs of number, than the ſmalneſs of bulk. Taking then ſome of the ripe and brown or reddiſh ones of them, and preſſing them pretty hard, I found, that there was a ſmall duſt went out of them, which ſeemed to vaniſh into the Air. Preſſing and ſqueezing others of theſe upon a black plate, and examining the powder with a Microſcope, I found it to be a great heap of exceeding ſmall Seeds, Globular, and pretty tranſparent. It is the ſmalleſt, I confeſs, I have yet ſeen, and, it may be, that has hitherto been diſcovered. And, unleſs that be a plant, which I diſcovered growing on the blighted leaves of Roſes, and that thoſe ſmall bodies be ſeed veſſels; or, unleſs thoſe Knobs, I have diſcovered on the top of mould, be the like; I cannot preſently imagine where there ſhould be found a ſmaller. For, I find, that there will need no leſs than thirty ſix hundred of them to be laid one by another in a line, to make the length of an Inch; and, to cover the Superficies of an Inch-ſquare, there will need no leſs than nine hundred and threeſcore thouſands, beſides twelve millions, of ſingle Seeds if laid quadrangularly, but if laid triangularly, there will need no leſs than two hundred and fourſcore thouſand, beſides ſeventeen Millions, of ſingle grains. And the number in a grain weight of them cannot be

leſs

leſs than one thouſand three hundred eighty two Millions and four hundred thouſand ſingle grains, about eighty of theſe ſquare Superficies of Seeds being laid one upon another in the Trigonal order, making, as near as I can gueſs, the thickneſs of a piece of fine Paper, a ſquare inch of which weigheth a grain. And though this may ſeem a moſt incredible narration; yet I would deſire ſuch as are apt to be too cenſorious, to take the pains to gather a few of theſe Seed-veſſels, and examine them as I have done, and then ſpeak what they find, and believe no more than their own ſenſe and reaſon will inform them, and they may eaſily ſee, that what I have aſſerted, will be rather ſhort of than exceed the real numbers. Now if this Shell of the Seed be thus ſmall, how much ſmaller muſt needs be the rudiment of the Plant that lies encloſed within it? And how eaſily may ſuch Seeds be drawn up into the Air, and carried from place and place, even to the tops of the higheſt Towers, or to places moſt remote, and be ſowed by the paſſing Air, or falling drops of Rain, on the boughs or branches of Trees, ſides and tops of Walls, Houſes, or Steeples? And it is not in the Art of man to leave Earth expoſed to the common Air, and to exclude the entrance, or prevent the ſowing of theſe imperceptible Seeds; and therefore it is not to be wondred at, that, if any earth, though never ſo pure, be expoſed to the Air and Rain, though at the top of a Steeple, it will produce Moſs.

Further inquiry may poſſibly inſtruct us, that there may be Seeds of Muſhroms, Mould and other Vegetables of as ſmall, if not ſmaller, bulk, which may be diſperſed and mingled with the Air, and carried to and fro with it, till waſhed down by the falling drops of Dews or Rains; which, if they chance to light on a convenient ſoyl, do there Vegetate and ſpring up; but dye and periſh, if the ground, they light on, be not natural and agreeable. But whether this conjecture hit right, further obſervation muſt determine.

This

This diſcovery I made the year after the late Fire of *London*, to wit, in the year 1667. there being then vaſt quantities of it to be found every where diſperſed among the Ruines left by that Fire, which made me, I confeſs, very much wonder at firſt how ſuch vaſt quantities ſhould come to be then ſo ſuddenly rooted, and was the occaſion of my more ſtrict examination of it. This I preſently ſhewed to many of my Acquaintants, and the next year 1668. upon the eleventh of *June* I brought an account of it into the *Royal Society*, where I ſuppoſe it may yet remain upon their Regiſter; and it was not a little ſurpriſing to all that ſaw it, when they conſidered how exceedingly ſmall each particular Seed was, and yet how infinitely vaſt the number of them was produced by each Plant. How prodigiouſly ſmall the firſt beginning and rudiment of that Plant muſt be that was produced by it; now, though indeed the Plant it ſelf be one of the ſmalleſt, yet this Seed of it was much ſmaller in compariſon to the Plant than the Seeds of moſt other Plants compared with theirs. But about two years after this I received from a very good friend of mine at *Briſtol*, the Ingenious and Inquiſitive Mr. *W. C.* a Relation of ſome later diſcoveries of his, which ſeemed much to outſtrip even this, whether the comparative magnitude of the Plant, and of the Seeds, or the number of the Seeds, or the curioſity of the Seed-boxes, or the ſtrange way of ſowing and diſperſing, or the place and manner of the Seeds production be conſidered. As they were ſent to me by him in a Letter from *Briſtol*, dated *September* 30. 1669. take them in his own words and deſcription.

NOtwithſtanding my many other Avocations, variety of diſcoveries do almoſt every day inlarge my experience; but more eſpecially this laſt Week I was very happy in the detecting of that which all the Philoſophers and Phyſicians of former Ages, have been ignorant of, as we may well imagine from what remains we have of them. My Diſcovery in ſhort was this, that all the kinds or ſpecies of Ferns together with

with all the like Capillary Plants their Congeners are (though generally denied to have any at all) more abundantly prolifical in Seeds than any other Plant beside, especially the common Female Ferns or Brakes, and those more elegantly formed (I mean chiefly in the little Vesicles containing the Seed) than many others, among the hundreds I have observed. To make it demonstrable to you, I have now sent you both the Plants with the Seeds on them, and the Seeds of the same Plants apart in Papers by themselves, which I took off from other Plants of the same kind, having plentiful parcels of each (excepting of what I have not sent you) this being the season of perfecting their Seeds. I thought to have sent you draughts of the Seed Vessels, as they appeared presently after gathering, but could not. I presume some of the Vesicles or little boxes may remain whole, so that by your Microscope you may see their true figures and distinctions, some of them being more flatted on each side the little ring or embossed girdle encompassing them, others more swelling.

Also those little rings or bands encompassing the boxes are different, in some of the kinds broader and flatter, in others rounder, and standing up higher, yet all agreeing in the principal parts of their form. I purpose to draw the figures of them all as they appear by the Microscope, together with their Seeds, and to add descriptions of all circumstances considerable, and joyn them to the rest of my draughts of that kind. Some particulars most considerable I now give you in the following account.

1. *The little boxes containing the Seeds are in most of these Plants not half, and in some not above one third, or one quarter as big as a very small grain of common white sand; appearing like little bladders infolded with rings or bands, shaped like certain little worms I have met with, which may be referred to the Teredo's and Eruca's.*

2. *As near as I could compute, some of these bladders contained about 100 Seeds, which were so exceeding small, as to be wholly invisible to the naked eye, and indiscoverable without a Microscope.*

3. *The*

3. *The Leaves of both the Ferns, especially the common Female Fern, (which is more abundantly ſtored with Seed than any of the reſt) and the other I now ſend you, being kept cloſe without bruiſing, and ſoon after gathering expoſed to the Sun, or dry Air, the bands of as many of them as are ripe, will contract themſelves and break, and fling their Seeds all about, after the ſame manner as ſome other ſmall Plants, ſuch as the* Perſicaria Siliquata, *and ſome of the* Cardaminas *are obſerved to do. This I have obſerved with a ſingle convex glaſs as well as with the Microſcope, but with the latter only I could diſcover the falling of the Seed. And a pretty quantity of the Seed being rubbed or bruſhed off from the Leaves upon a fine piece of Paper or Parchment, and ſweeped together into a heap, many of thoſe boxes breaking together, and juſtling one another would make the heap ſeem, as it were, full of Mites or living Creatures, even to the bare eye; and if the place be free from noiſe, and the Ear be cloſe applied, the crackling of them upon breaking may eaſily enough be heard, and upon running over the Paper with a Microſcope the Seeds will be found diſperſed, and thrown at a great diſtance.*

4. *The figures of the Seed-veſſels, as alſo of the Seeds of all the Ferns and thoſe their Congeners, called Capillary Plants, are very near of the ſame ſhape and ſize, notwithſtanding the vaſt diſproportion between them, as particular common Fern, Wall Rue, Harts Tongue, and Oſmond Royal, the firſt three of which being very remarkable for their unlikeneſs to each other, and the laſt chiefly for its excelling ſo many thouſand times in magnitude that of Wall Rue. Which obſervations may ſeem to confirm the opinions of ſome learned Botaniſts that the affinity of Plants are to be judged by the figures of their Seeds.*

5. *That Oſmund Royal, which excelleth all the other Ferns both in greatneſs, comlineſs, and vertues, and which hath been accounted barren, with the reſt hath Veſſels and Seeds of the ſame figure with the other, and very near of the ſame ſize, the extreme ſmalneſs of which, even to inviſibility, and the greatneſs of the Plant, one root whereof, with all the growth out of it, I have found weighing ten pounds and bet-*

ter, is ſurpaſſingly more wonderful than that of Moſs Seeds; of which I have ſome kinds of them bearing Seeds, that a great number of them, with their Roots, Stalks, Leaves, and Seeds, do not weigh a Grain. Beſides, I have found of the common Female Fern ſome which have been from the Roots to the utmoſt top of the Leaf nine foot high, and within theſe three days meaſured the common broad-leaved Male Fern ſix foot and an half long; ſome of the Leaves of which are among thoſe I now ſend you.

6. But that which appeared moſt admirable, both to me and ſome other Gentlemen that were witneſſes of it with me, was the many differing kinds of ſmall living Creatures, wholly inviſible to the naked eye, and even through largely magnifying ſpectacles, though ſome of them were to be ſeen through a deep Convex glaſs; but with a Microſcope, when the Plant was newly gathered, they might be ſeen nimbly running up and down among the Seed-veſſels, and ſome of them were ſo ſmall as not to be above twice as big as the ſmall Seeds in the bladders; a deſcription of ſome of which I may hereafter ſend you.

I have incloſed in the box ſent you twelve ſorts of Plants of this tribe, being the greateſt part of the number, and only ſeven ſorts of the Seeds; thoſe wanting are the Cetrach, Wall Rue, Maiden-hair, and Polypody, of which notwithſtanding you may ſatisfie your ſelf in the mean time till I can ſend them green by thoſe ſmall parcels of the Plants which you will find amongſt the reſt, though by keeping they are withered.

The Seeds of the Ferns through a very excellent Microſcope appeared of the bigneſs of a ſmall Vetch or Seed of Lentiles to the naked eye, and ſome of them ſhrink like the ſides of white Peaſe, with ſmall regular knobs and hollows. Thoſe of Polypody are differing in colour and ſhape being yelloviſh, as the others are brown, red, and formed like the Seeds of the ſmaller Medicas that is of a Kidney ſhape. All the reſt I found very near of the ſame form. I cannot omit what I obſerved in Cetrach, which Plant I have heretofore often conſidered, and wondred at the ill-favoured roughneſs on the under

der ſide of the Leaf, appearing like the fleſhy ſide of tann'd Leather, being wholly ignorant what Nature meant in it, but now by my Microſcope I find it a very pleaſant object differing from all the reſt, wherein the curioſity of Nature (in a Plant ſo abject as that appears) is ſtewn beyond imagination. This, when freſh gathered, and not bruiſed, appears through the Microſcope like fine thin Membranes, ſuch as the Wings of Flies, chequered with figures after the manner of Honeycombs when the cells are full of honey, and cloſed with Membranes, amongſt which, as in ſo many Cells, lie the Seed-veſſels, ſhaped as before is mentioned. I doubt not but you have read the ſtrange ſtories and fabulous conceits of Authors about Fern Seeds. But Parkinſon *is more Orthodox in ſome things than any of them: For he poſitively concludes from* Gen. 1. 11, 12. *that all Plants have their Seeds, and conſequently Fern; where if he had ſtaid, he had aſſerted a general truth: But in coming to particulars, he affirms as great an untruth, in ſaying,* fol. 1036, *and* 1037. *that the Seed is ripe at Midſummer, according to the old traditional Fable, and tells how it may be gathered; whereas now is the very ſeaſon of their ſeeding, and at Midſummer this and the reſt are not come to their full growth, before which no Plant ſeeds. That duſtineſs which he ſpeaks of, and calls the Seed, is no other than what is found on divers other Plants, being an irregular Duſt, and is not found on the borders of the dents of the Leaves on the under ſide, on which the Seed grows, but all over ſprinkled on both ſides, and not found when it is fully grown. This he affirms of the Male Ferns, which are all differing very notably from the common Female Fern, concerning which the fabulous tradition is held. But after in the following Chapter of the Ferns and their Relatives now ſent you, he ſeems to give over his Scripture Propoſition, and, ſpeaking of the Seeds, ſays no more but that they have ſpots, daſhes, ſcales, or marks on their back-ſides. And of the Oſmund Royal (ſpeaking of the buſh at the top of the Plant) ſays it is accounted as the Flower and Seeds. And of the* Lonchitis aſpera *ſays plainly they have none at all. Of this laſt I am yet to enquire, but doubt not I ſhall find that it hath*

Seed like the reſt. Of all which Gerrard *and* Johnſon *his Corrigitor gravely concludes (having indeed no demonſtrable ground to the contrary) that ſome have been too raſh in affirming Ferns to have Seed. I intend next Summer to obſerve whether theſe hitherto unknown Seeding Plants have Flowers. In the mean time* I am, *&c.*

Briſtol. *September* 30. 1669. W. C.

Maculæ in Sole.

DUring this laſt great heat of weather in *June* I obſerved a very conſpicuous Macula with its immediatly incompaſſing Nubecula, and ſome other leſs conſpicuous Spots at a further diſtance paſs over the Disk of the Sun, and found that it was neareſt the middle when the heat was greateſt, that the heat increaſed as it came nearer the middle, and decreaſed as it departed from it. It may be therefore worth obſerving for the future whether the like weather do not happen upon the next appearance of the like Macula, ſince it ſeems not very improbable to ſuppoſe that the body of the Sun it ſelf may be much hotter when ſuch eruptions appear, theſe Maculæ often times ending in Fæculæ. And the rather becauſe I am informed that this extraordinary heat hath not been peculiar only to *England*, but very general to *Europe*; what it hath been to other parts of the world further intelligence will inform us.

Upon a ſecond appearance of Spots in the Disk of the Sun at the latter end of *July* and the beginning of *Auguſt*, when at one time, to wit, *July* 29. there appeared about ſix greater and ſmaller in one knot with their proper Nubecules or Umbra's, the heat of the weather again increaſed to a very great degree, and abated as they drew toward the Limb, and grew fainter. But it hath now ſince the diſappearing, *viz.* on the fourth of *Auguſt*, been exceeding hot alſo, though I do not find any Spots this ſeventh of *Auguſt*; it may therefore poſſibly be that other parts of the body of the Sun may have an extraordinary inflammation

inflammation which may cauſe ſo fervent and laſting heats as have hapned this Summer. At leaſt this Hint may deſerve ſome farther Inquiry, for though probably it may not be attained to predict the appearances of thoſe Spots, yet poſſibly the appearances of the Spots may ſerve to predict the future conſtitution of the weather. At leaſt it ſeems worthy remarking that the greateſt heat that hath been in the Air this year was on that day of *June* when the firſt Spot was near the middle of the Sun.

POSTSCRIPT.

THe Publiſher of Tranſactions in that of *October* 1675. indeavours to cover former injuries done me by accumulating new ones, and this with ſo much paſſion as with integrity to lay by diſcretion; otherwiſe he would not have affirmed, that it was as certain that none of my Watches ſucceeded, as it was that I had made them ſeveral years ago: For how could he be ſure of a Negative? Whom I have not acquainted with my Inventions, ſince I looked on him as one that made a trade of Intelligence.

Next whereas he ſays I made them without publiſhing them to the world *in Print*, he prevaricates, and would have it believed that they were not publiſhed to the world, though they were publickly read of in Sir *John Cutlers* Lectures before great numbers at ſeveral times, and though they were made and ſhewn to thouſands both Engliſh and Foreiners, and writ of to ſeveral perſons abſent, and though they were in the year 1665. in the Hiſtory of the *Royal Society* publiſhed to the world in Print, becauſe, forſooth, they were not printed in his Tranſactions.

Thirdly, whereas the Publiſher of Tranſactions makes a long ſtory of my ſeeing his Journal *De ſcavans*, and my deſiring to tranſcribe that part of it which concerned this matter, as if I had requeſted ſome ſingular favour thereby. I anſwer,

Firſt,

First, that he knew I designed presently to have printed it with Animadversions, but he endeavoured to prevent me, designing first clancularly to get a Patent of it for himself, and thereby to defraud me.

Next, I say, I had a right without his favour to have seen, perused, and copied it, as I was one of the *Royal Society*, the intelligence he there brings in being the *Societies*.

Then it is denied that the Describer of Helioscopes well knew that the Transcriber of Intelligence would publish it in his Transactions, though it was believed if the publishing it would injure me it would not be long concealed; which was the sole reason of Printing in the same Transactions, *viz.* 112. a Letter which he had several years before.

Thirdly, Whereas he asserts that several discoveries of the Accuser had been vindicated from the usurpation of others. It is answered, the clean contrary is upon good grounds suspected from the Publication of a Book about Earthquakes, Petrifactions, *&c.* Translated and Printed by H. O. the manner of doing which is too long for this place. Such ways this mis-informer hath of vindicating discoveries from the usurpation of others.

To his upbraiding me with his having published some things of Mine; I answer, he hath so, but not so much with mine as with his own desire, and if he send me what I think worth publishing I will do as much for him, and repay him in his own coyn.

Lastly, Whereas he makes use of We and Us ambiguously, it is desired he would explain whether he means the *Royal Society*, or the Pluralities of himself. If the former, it is not so, as I can prove by many Witnesses; if the later, I neither know what he is acquainted with, or what has been imparted or explained to him.

So not designing to trouble my self any further with him, unless he gives me occasion, I dismiss him with his

——— *Speque metuque*
Procul hinc procul ito. Ho.

FINIS.